NOTICE

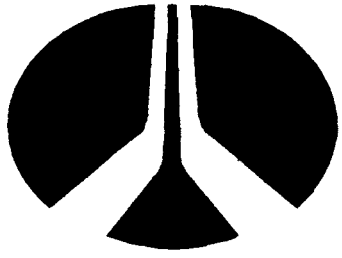
All drawings located at the end of the document.

Interim Status Closure Plan
Solid Waste Management Unit 15
(Storage Pad 904)

For U.S. D.O.E.-Rocky Flats Plant
Low-Level Mixed Wastes

CO7890010526

30 September 1989



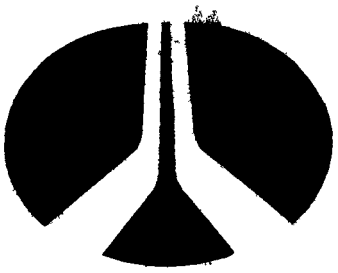
Rockwell International

Interim Status Closure Plan
Solid Waste Management Unit 15
(Storage Pad 904)

For U.S. D.O.E.-Rocky Flats Plant
Low-Level Mixed Wastes

CO7890010526

30 September 1989



Rockwell International

ADMIN RECORD

REVIEWED FOR CLASSIFICATION/UCNI
By F J Curran
Date 3-19-91

TABLE OF CONTENTS

SECTION			PAGE
1.0	INTRODUCTION		1
	1.1	Plant Location and Mission	1
	1.2	Closure Plan Purpose	3
2.0	FACILITY DESCRIPTION		5
	2.1	Facility Location and Specifications	5
	2.2	Facility Operation	9
		2.2.1 Periods of Operation	9
		2.2.2 Maximum Waste Inventory	10
		2.2.3 Types of Waste Managed	12
		2.2.4 Waste Process Description	15
		2.2.5 Monitoring and Containment Systems	21
		2.2.5.1 Air monitoring and containment	21
		2.2.5.2 Surface water monitoring and containment	25
		2.2.5.3 Soil monitoring and containment	27
		2.2.5.4 Groundwater monitoring and containment	41
		2.2.5.4.1 Regional Alluvial Geology	41
		2.2.5.4.2 Regional Bedrock Geology	43
		2.2.5.4.3 Site Alluvial Geology	46
		2.2.5.4.4 Site Bedrock Geology	50
		2.2.5.4.5 Site Alluvial Hydrogeology	50
		2.2.5.4.6 Site Bedrock Hydrogeology	53
		2.2.6 Releases	62
		2.2.6.1 Releases to the Pad	62
		2.2.6.2 Releases to the Air	66
		2.2.6.3 Releases to Surface Water	66
		2.2.6.4 Releases to Soil	79
		2.2.6.5 Releases to Groundwater	80
3.0	CLOSURE PLAN SUMMARY		86
	3.1	Closure Objectives	86
	3.2	Closure Activities	86
	3.3	Closure Schedule	87
	3.4	Administration of the Closure Plan	89
4.0	REMOVAL OF HAZARDOUS WASTE INVENTORY		90
5.0	OFF-SITE WASTE MANAGEMENT		91

TABLE OF CONTENTS (CONT.)

SECTION		PAGE
6.0	DECONTAMINATION	92
	6.1 Closure Performance Criteria	92
	6.2 Decontamination of Pad 904	96
	6.3 Decontamination of Auxiliary Equipment	98
	6.4 Decontamination of Equipment Used During Closure	99
	6.5 Contaminated Soils	99
	6.6 Removal of Hazardous Waste Residues	100
7.0	DECONTAMINATION VERIFICATION	101
	7.1 Pad 904	101
	7.2 Surface Water	102
	7.3 Soils	102
	7.3.1 Beneath Pad 904	102
	7.3.2 Adjacent to Pad 904	103
	7.4 Groundwater	104
	7.5 Analytical Methods	104
8.0	CLOSURE SCHEDULE	105
9.0	CLOSURE COST AND FINANCIAL ASSURANCE	106
10.0	SITE ACCESS AND SECURITY	108
11.0	HEALTH AND SAFETY	109
12.0	POST-CLOSURE MONITORING	110
13.0	CLOSURE CERTIFICATION	111
14.0	REFERENCES	112

LIST OF TABLES

TABLE NUMBER	TITLE	PAGE
1	Pondcrete Hazardous Waste Numbers and Maximum Concentrations of Hazardous Constituents	13
2	Saltcrete Hazardous Waste Numbers and Maximum Concentrations of Hazardous Constituents	16
3	Summary of Soil Chemical Data at and Near Pad 904 Pondcrete Storage Area	29
4	Groundwater Sampling Parameters	58
5	Isotope Specific Analyses Before Spill (June 26, 1988) and After Spill (July 22, 1988)	75
6	Groundwater Concentrations in the Area of Pad 904	81
7	Mobility of Hazardous Compounds Identified in Saltcrete or Pondcrete	94
8	Decontamination Indicators	95
9	General Purpose Decontamination Solutions for Hazardous, Radioactive and TRU-Mixed Wastes	97
10	Cost Estimate for Closure of Unit 15	107

LIST OF FIGURES

FIGURE NUMBER	TITLE	PAGE
1	Vicinity Map	2
2	Rocky Flats Plant Controlled Area	6
3	Pad 904 - Location Map	7
4	Pad 904 - Details	8
5	Waste Process Description	20
6	Ambient Air Monitoring Locations	23
7	Plutonium-239 Isoconcentrations in Soil (April, 1987)	28
8	Plutonium-239 Isoconcentrations in Soil (August/September, 1987)	31
9	Nitrate Isoconcentrations in Soil (May, 1988)	33
10	Plutonium-239 Isoconcentrations in Soil (May, 1988)	34
11	Uranium-234 Isoconcentrations in Soil (May, 1988)	35
12	Uranium-238 Isoconcentrations in Soil (May, 1988)	36
13	Americium-241 Isoconcentrations in Soil (October, 1988)	38
14	Total Plutonium Isoconcentrations in Soil (October, 1988)	39
15	Total Uranium Isoconcentrations in Soil (October, 1988)	40
16	Geologic Cross-Section Location Map	42
17	Generalized Geologic Cross Section	44
18	Geologic Cross-Section A-A'	47
19	Geologic Cross-Section B-B'	48
20	Geologic Cross-Section C-C'	49

LIST OF FIGURES (Con't)

FIGURE NUMBER	TITLE	PAGE
21	Alluvial Aquifer Potentiometric Map (April, 1988)	51
22	Bedrock Aquifer Potentiometric Map (April, 1988)	54
23	Pad 904 Surface Water Flow Patterns	68
24	Rocky Flats and Boulder Precipitation Data	69
25	Gross Alpha Concentrations in Puddle Samples	71
26	Gross Beta Concentrations in Puddle Samples	72
27	Nitrate Concentrations in Puddle Samples	73
28	Probability of Gross Alpha Concentrations in Pad 904 Runoff	76
29	Probability of Gross Beta Concentrations in Pad 904 Runoff	77
30	Probability of Gross Nitrate Concentrations in Pad 904 Runoff	78
31	Schedule of Closure Activities	88

LIST OF APPENDICES

APPENDIX A - PRODUCTION PROCESS DESCRIPTION FOR PONDCRETE AND SALTCRETE FROM SECTION D OF RCRA PART B PERMIT

APPENDIX B - BORING LOGS FOR WELLS IN THE AREA OF PAD 904

APPENDIX C - HYDROGRAPHS FOR WELLS IN THE AREA OF PAD 904

APPENDIX D - RCRA CONTINGENCY IMPLEMENTATION PLAN REPORTS AND MONTHLY PONDCRETE STATUS REPORTS

APPENDIX E - PAD 904 RUNOFF DATA

REGULATORY CHECKLIST FOR UNIT 15
PONDCRETE STORAGE AREA PAD 904

PART/REQUIREMENT	CLOSURE PLAN SECTION
Subpart A - General	
265.1 Purpose, scope, and applicability.	1.0,2.0
a. The purpose of this part is to establish minimum state standards that define the acceptable management of hazardous waste during the period of interim status and until certification of final closure...	
b. The standards of this part apply to owners and operators of facilities that treat, store or dispose of hazardous waste who have fully complied with the requirements for interim status under Section 3005(e) of RCRA and Parts 99 and 100 of this Chapter until either a permit is issued or until applicable Part 265 closure and post-closure responsibilities are fulfilled, and to those owners and operators of facilities in existence on November 19, 1980 who have failed to provide timely notification as required by Section 3010(a) of RCRA and/or failed to file Part A of the permit application as required by Parts 99 and 100 of these regulations, except as specifically provided otherwise in this Part or Part 261 of these regulations.*	

*These provisions, with regard to off-site disposal facilities, will be applied in accordance with C.R.S. 1973, 25-15-101 et seq.

REGULATORY CHECKLIST FOR UNIT 15 (Con't)
PONDCRETE STORAGE AREA PAD 904

PART/REQUIREMENT	CLOSURE PLAN SECTION
Subpart G - Closure and Post Closure	1.0
265.110 Applicability. Except as § 265.1 provides otherwise: a. Sections § § 265.111-265.115 (which concern closure) apply to the owners and operators of all hazardous waste management facilities.	
Closure Performance Standard	
265.111	3.0,6.0, 7.0
The owner or operator must close his facility in a manner that: a. Minimizes the need for further maintenance; and b. Controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous constituents, leachate, contaminated runoff, or hazardous waste decomposition products to the ground or surface water or to the atmosphere; and c. Complies with the closure requirements of this Subpart...	

REGULATORY CHECKLIST FOR UNIT 15 (Con't)
PONDCRETE STORAGE AREA PAD 904

PART/REQUIREMENT	CLOSURE PLAN SECTION
Closure Plans; amendment of plan	
265.112	
a. Written plan.	8.0
By May 19. 1981, the owner or operator of a hazardous waste management facility must have a written closure plan. Until final closure is completed and certified in accordance with Section 265.115, a copy of the most current plan must be furnished to the Department upon request, including request by mail. In addition, for facilities without approved plans, it must also be provided during site inspection, on the day of inspection, to any officer, employee or representative of the Department who is duly designated by the Director.	
b. Content of plan.	4.0,5.0 6.0,7.0
The plan must identify the steps necessary to perform partial and/or final closure of the facility at any point during its active life. The closure plan must include, at least:	
1. A description of how each hazardous waste management unit at the facility will be closed in accordance with Section 265.111; and	

REGULATORY CHECKLIST FOR UNIT 15 (Con't)
PONDCRETE STORAGE AREA PAD 904

PART/REQUIREMENT	CLOSURE PLAN SECTION
2. A description of how final closure of the facility will be conducted in accordance with Section 265.111. The description must identify the maximum extent of the operations which will be unclosed during the active life of the facility; and	
3. An estimate of the maximum inventory of hazardous wastes ever on-site over the active life of the facility and a detailed description of the methods to be used during partial closures and final closure, including, but not limited to, methods for removing, transporting, treating, storing, or disposing of all hazardous wastes, and identification of the type(s) of the off-site hazardous waste management units to be used, if applicable; and	2.0,6.0
4. A detailed description of the steps needed to remove or decontaminate all hazardous waste residues and contaminated containment system components, equipment, structures, and soils during partial and final closure, including, but not limited to, procedures for cleaning equipment and removing contaminated soils, methods for sampling and testing surrounding soils, and criteria for determining the extent of decontamination necessary to satisfy the closure performance standard; and	2.0,6.0

REGULATORY CHECKLIST FOR UNIT 15 (Con't)
PONDCRETE STORAGE AREA PAD 904

PART/REQUIREMENT	CLOSURE PLAN SECTION
5. A detailed description of other activities necessary during the partial and final closure period to ensure that all partial closures and final closure satisfy the closure performance standards, including, but not limited to, ground-water monitoring, leachate collection, and run-on and run-off control; and	6.0
6. A schedule for closure of each hazardous waste management unit and for final closure of the facility. The schedule must include, at a minimum, the total time required for intervening closure activities which will allow tracking of the progress of partial and final closure. (For example, in the case of a landfill unit, estimates of the time required to treat or dispose of all hazardous waste inventory and of the time required to place a final cover must be included); and	8.0
7. As estimate of the expected year of final closure for facilities that use trust funds to demonstrate financial assurance under Section 266.14 and whose remaining operating life is less than twenty years, and for facilities without approved closure plans.	9.0

REGULATORY CHECKLIST FOR UNIT 15 (Con't)
PONDCRETE STORAGE AREA PAD 904

PART/REQUIREMENT	CLOSURE PLAN SECTION
c. Amendment of plan. The owner or operator may amend the closure plan at any time prior to the notification of partial or final closure of the facility. An owner or operator with an approved closure plan must submit a written request to the Department to authorize a change to the approved closure plan. The written request must include a copy of the amended closure plan for approval by the Department.	6.0,7.0
1. The owner or operator must amend the closure plan whenever: i. Changes in operating plans for facility design affect the closure plan, or ii. There is a change in the expected year of closure, if applicable, or iii. In conducting partial or final closure activities, unexpected events require a modification of the closure plan.	7.0
2. The owner or operator must amend the closure plan at least 60 days prior to the proposed change in facility design or operation, or no later than 60 days after an unexpected event has occurred which has affected the closure plan. If an	8.0

PART/REQUIREMENT	CLOSURE PLAN SECTION

unexpected event occurs during the partial or final closure period, the owner or operator must amend the closure plan no later than 30 days after the unexpected event. These provisions also apply to owners or operators of surface impoundments and waste piles who intended to remove all hazardous waste at closure, but are required to closure as landfills in accordance with Section 265.310.

d. The Director will provide the owner or operator and the public, through a newspaper notice, the opportunity to submit written comments on the plan and request modification of the plan within 30 days of the date of the notice. He will also, in response to a request or at his own discretion, hold a public hearing whenever such a hearing might clarify one or more issues concerning a closure plan. The Director will give public notice of the hearing at least 30 days before it occurs. (Public notice of the hearing may be given at the same time as notice of the opportunity for the public to submit written comments, and the two notices may be combined.) The Department will approve, modify, or disapprove the plan within 90 days of its receipt. If the Department does not approve the plan, the owner or operator must modify the plan or submit a new plan for approval within 30 days. The Department will approve or modify this plan in writing within 60 days. If the Department modifies the plan, this modified plan becomes the approved closure plan. The Department's decision must

PART/REQUIREMENT	CLOSURE PLAN SECTION
assure that the approved closure plan is consistent with § 265.111, 265.113, 265.114, and 265.115... A copy of this modified plan must be mailed to the owner or operator.	
Closure; time allowed for closure.	
265.113	8.0
a. Within 90 days after receiving the final volume of hazardous wastes, or 90 days after approval of the closure, if that is later, the owner or operator must treat, remove from the site, or dispose of on-site all hazardous wastes in accordance with the approved closure plan. The Department may approve a longer period using the procedures under § 265.112(d) if the owner or operator demonstrates that:	
1. i. The activities required to comply with this paragraph will, of necessity, take him longer than 180 days to complete;	
ii. (a) The facility has the capacity to receive additional wastes;	
(b) There is a reasonable likelihood that a person other than the owner or operator will recommence operation of the site; and	

xiv

PART/REQUIREMENT	CLOSURE PLAN SECTION
(c) Closure of the facility would be incompatible with continued operation of the site; and	
2. He has taken and will continue to take all steps to prevent threats to human health and the environment.	
b. The owner or operator must complete closure activities in accordance with the approved closure plan and within 180 days after receiving the final volume of wastes or 180 days after approval of the closure period using the procedures under § 265.112(c) if the owner or operator demonstrates that:	8.0
1. i. The closure activities will, of necessity, take him longer than 180 days to complete;	
ii. (a) The facility has the capacity to receive additional waste;	
(b) There is a reasonable likelihood that a person other than the owner or operator will recommence operation of the site;	

XV

REGULATORY CHECKLIST FOR UNIT 15 (Con't)
PONDCRETE STORAGE AREA PAD 904

PART/REQUIREMENT	CLOSURE PLAN SECTION
(c) Closure of the facility would be incompatible with continued operation of the site; and	
2. He has taken and will continue to take all steps to prevent threats to human health and the environment from the unclosed but inactive facility.	
Disposal or decontamination of equipment. 265.114	6.0
a. When closure is completed, all facility equipment and structures must have been properly disposed of, or decontaminated by removing all hazardous waste and residues.	
1. Physical contact with the waste, structures, or equipment within the active portion of the facility will not injure unknowing or unauthorized persons or livestock which may enter the active portion of a facility, and	10.0,12.0

XVI

PART/REQUIREMENT	CLOSURE PLAN SECTION
2. Disturbance of the waste or equipment, by the unknowing or unauthorized entry of persons or livestock onto the active portion of a facility, will not cause a violation of the requirements of this part.	
b. Unless exempt under paragraphs (a)(1) and (a)(2) of this section, a facility must have:	12.0
1. A 24-hour surveillance system (e.g., television monitoring or surveillance by guards or facility personnel) which continuously monitors and controls entry onto the active portion of the facility; or	
2. i. An artificial or natural barrier (e.g., a fence in good repair or a fence combined with a cliff), which completely surrounds the active portion of the facility; and	
ii. A means to control entry, at all times, through the gates or other entrances to the active portion of the facility (e.g., an attendant, television monitors, locked entrance, or controlled roadway access to the facility).	

PART/REQUIREMENT	CLOSURE PLAN SECTION

c. Unless exempt under paragraphs (a)(1) and (a)(2) of this section, a sign with the legend, "Danger - Unauthorized Personnel Keep Out", must be posted at each entrance to the active portion of a facility, and at other locations, in sufficient numbers to be seen from any approach to the active portion. The legend must be written in English and in any other language predominant in the area surrounding the facility and must be legible from a distance of at least 25 feet. Existing signs with a legend other than "Danger - Unauthorized Personnel Keep Out" may be used if the legend on the sign indicates that only authorized personnel are allowed to enter the active portion, and the entry onto the active portion can be dangerous.

Certification of closure.

254.115 — 13.0

When closure is completed, the owner or operator must submit to the Department certification both by the owner or operator and by an independent registered professional engineer that the facility has been closed in accordance with the specifications in the approved closure.

REGULATORY CHECKLIST FOR UNIT 15 (Con't)
PONDCRETE STORAGE AREA PAD 904

PART/REQUIREMENT	CLOSURE PLAN SECTION
Subpart I - Use and Management of Containers	
Applicability*	
265.170	
The regulations in this Subpart apply to owners and operators of all hazardous waste facilities that store containers of hazardous waste, except as § 265.1 provides otherwise.	
Condition of containers.	
265.171	2.0
If a container holding hazardous waste is not in good condition, or if it begins to leak, the owner or operator must transfer the hazardous waste from this container to a container that is in good condition, or manage the waste in some other way that complies with the requirements of the Part.	

xix

REGULATORY CHECKLIST FOR UNIT 15 (Con't)
PONDCRETE STORAGE AREA PAD 904

PART/REQUIREMENT	CLOSURE PLAN SECTION
Compatibility of waste with container.	
The owner or operator must use a container made of or lined with materials which will not react with, and are otherwise compatible with, the hazardous waste to be stored, so that the ability of the container to contain the waste is not impaired.	
Management of containers.*	
265.173	2.0
a. A container holding hazardous waste must always be closed during storage, except when it is necessary to add or remove waste.	
b. A container holding hazardous waste must not be opened, handled, or stored in a manner which may rupture the container or cause it to leak.	
Inspections	
265.175	2.0
The owner or operator must inspect areas where containers are stored, at least weekly, looking for leaks and for deterioration caused by corrosion or other factors.	

XX

REGULATORY CHECKLIST FOR UNIT 15 (Con't)
PONDCRETE STORAGE AREA PAD 904

PART/REQUIREMENT	CLOSURE PLAN SECTION
*Re-use of containers in transportation is governed by U.S. Department of Transportation regulations and the Colorado Public Utilities Commission, including those set forth in 49 CFR 173.28.	
Part 266 Colorado Financial Requirements	
Applicability	
266.10	9.0
(a). The requirements of Section 266.12, 266.14 and 266.16 through 266.17 apply to owners and operators of all hazardous waste facilities, except as provided otherwise in this section or in § 264.1.	
(c). The State of Colorado and the Federal Government are exempt from the requirements of Part 266 of these regulations.	

INTERIM STATUS CLOSURE PLAN
SOLID WASTE MANAGEMENT UNIT #15
STORAGE PAD 904

1.0 INTRODUCTION

1.1 Plant Location and Mission

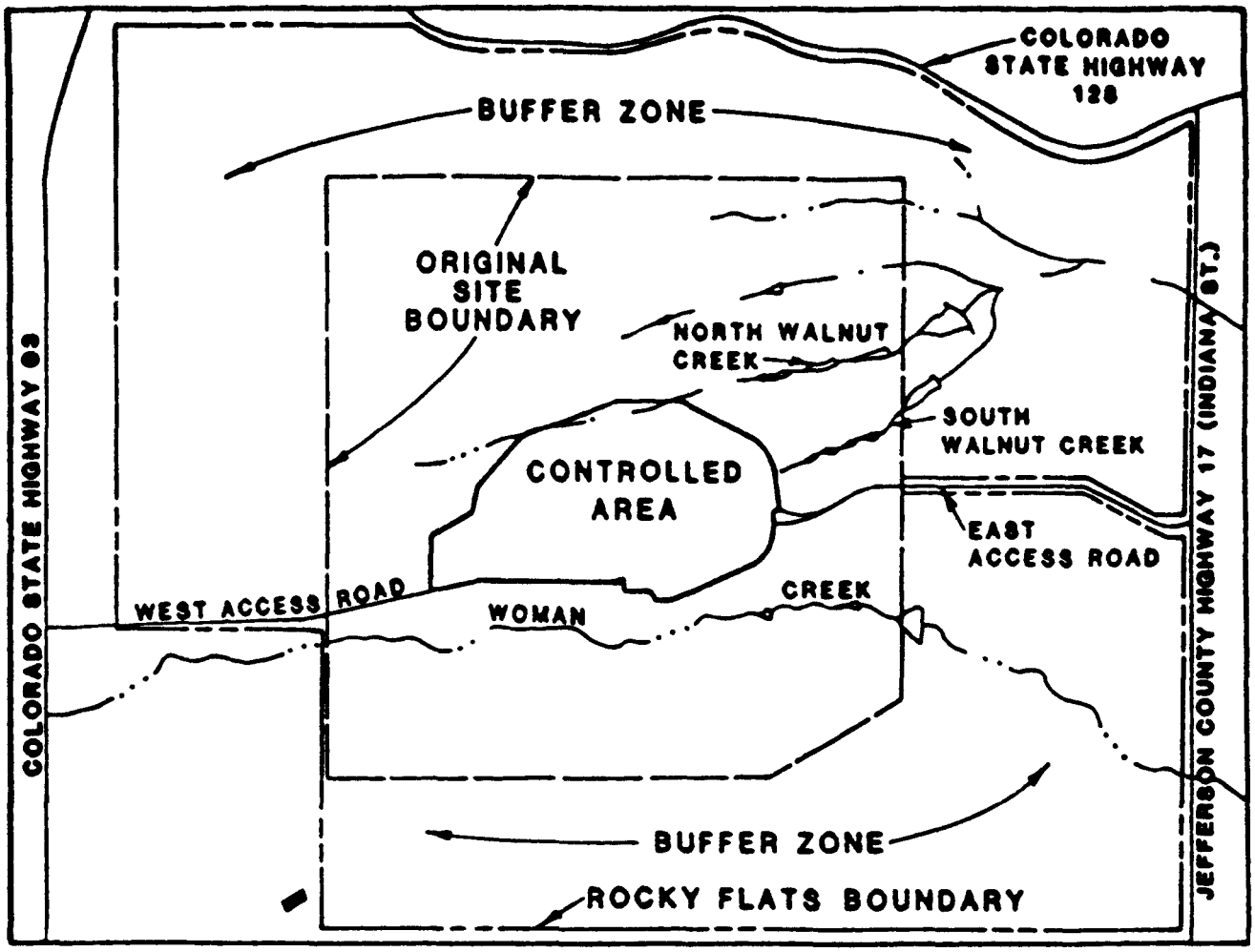
The U.S. Department of Energy's Rocky Flats Plant is located in north-central Colorado, northwest of the City of Denver (Figure 1). The Plant is located in Sections 1 through 4 and 9 through 15 of T.1 S., R. 70 W. The facility's EPA identification number is CO 7890010526. The mailing address is:

U.S. Department of Energy
Rocky Flats Plant
P.O. Box 464
Golden, CO 80402

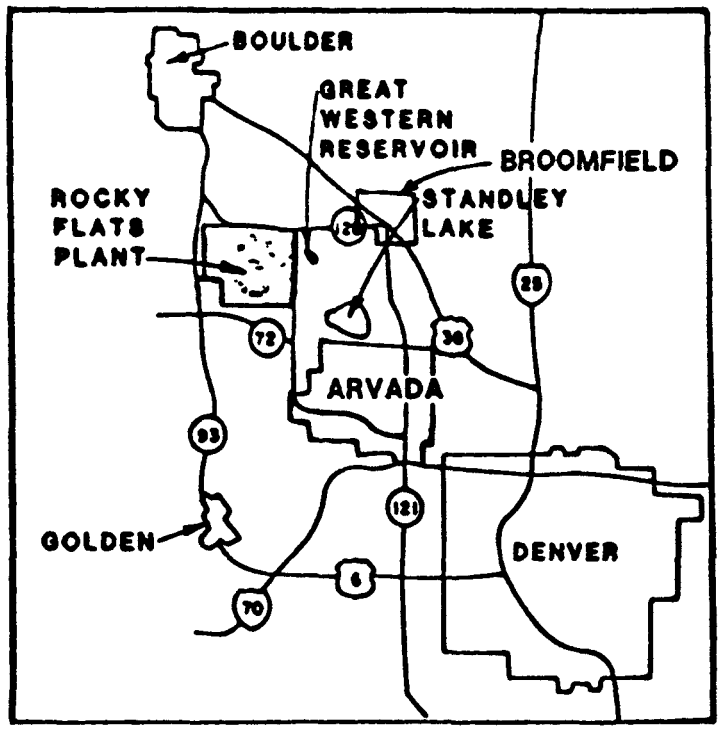
The facility contact is:

David P. Simonson
Manager
Department of Energy
Rocky Flats Operations (RFO)
Phone: 303-966-2025

Rockwell International is the prime operating contractor for Rocky Flats Plant (since June 1975) under the general direction of the U.S. Department of Energy (DOE), Washington D.C. Headquarters. As a government-owned and contractor-operated facility, the Rocky The primary Plant mission is to produce plutonium components for Flats



APPROXIMATE SCALE 1"=3,300'



APPROXIMATE SCALE 1"=40,000'

N

VICINITY MAP

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO
FIGURE 1

Plant comprises a portion of the nationwide nuclear weapons production complex.

The primary Plant mission is to produce plutonium components for nuclear weapons. Plutonium, uranium, beryllium, and stainless steel parts are fabricated at the Plant and shipped off-site for final assembly. Additional activities include chemical processing to recover plutonium from scrap material, metallurgical research and development, machining, assembly, non-destructive testing, coatings, remote engineering, chemistry, and physics. Waste handling operations at the Rocky Flats Plant include storage, transport, treatment, and packaging of waste materials generated on-site. The waste forms that are handled include hazardous chemical waste, transuranic (TRU) waste, non-hazardous, non-radioactive waste, and combinations thereof. Specifically, this Interim Status Closure Plan addresses containerized storage of mixed low-level radioactive and hazardous waste.

1.2 Closure Plan Purpose

Submittal of a closure plan is required to ensure that facilities that cease handling hazardous waste do not pose a long-term threat to human health and the environment. A RCRA Part B Permit Application has been prepared and submitted by the Rocky Flats Plant that includes a description of the operations at Solid Waste Management Unit (SWMU) Number 15. This unit is commonly referred to as the 904 Storage Pad, or Pad 904. Pad 904 currently is operating as an interim status storage unit (SWMU No. 15). Closure plans for units that have interim status and are currently out of service have been appended to the RCRA Post-Closure Care Permit Application. Only the section of this unit which stores Pondcrete

and Saltcrete will be closed under interim status since an operating permit will not be issued for this unit.

This closure plan describes activities necessary to close Pad 904 in compliance with the Part 265 closure regulations and in accordance with the Compliance Agreement entered into by the U.S. Environmental Protection Agency (EPA), DOE, and the Colorado Department of Health (CDH). This plan addresses Colorado Hazardous Waste Regulations under 6 CCR 1007-3, Part 265, Subpart G, Closure and Post-Closure; Section 265, Subpart I, Use and Management of Containers; and equivalent Federal regulations.

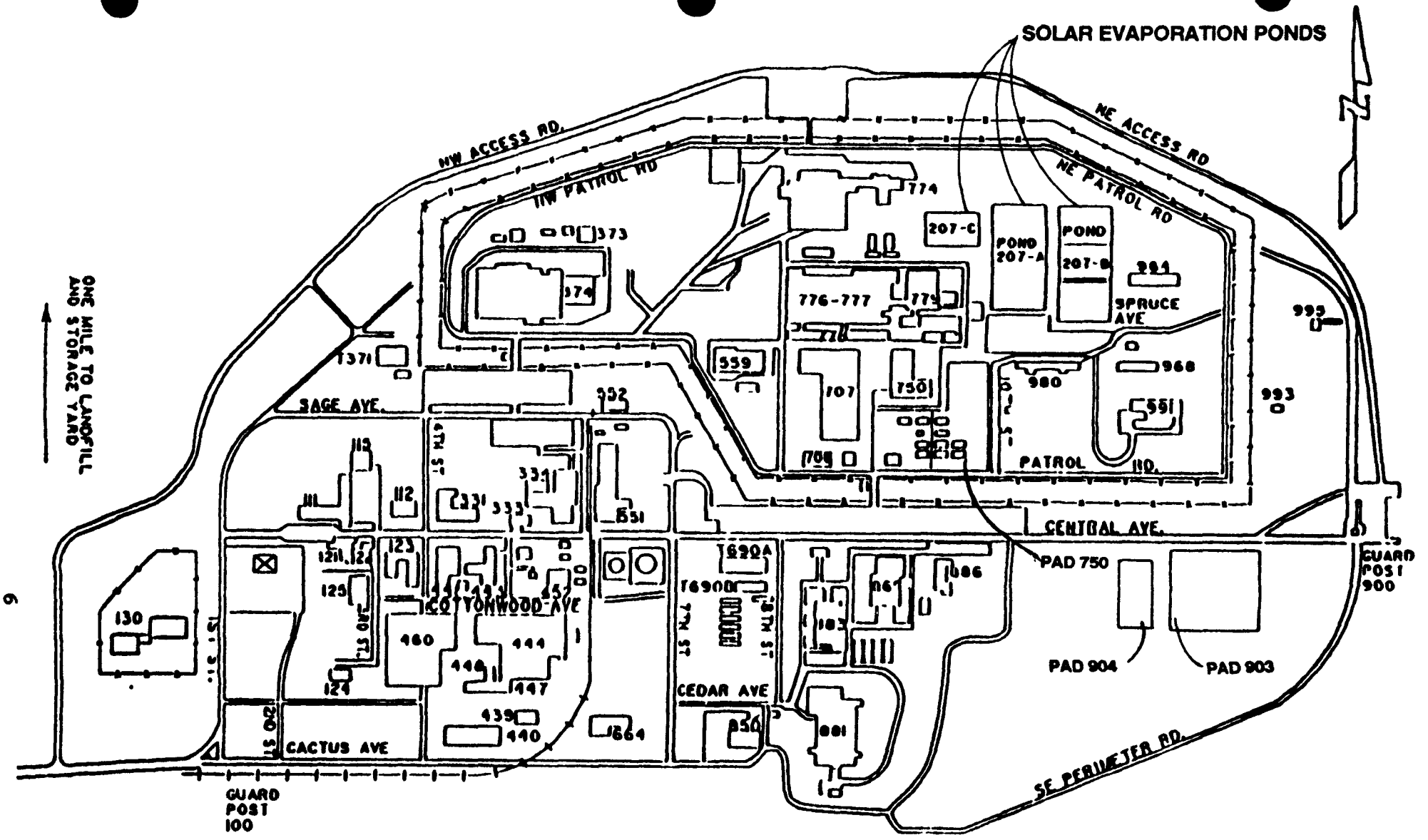
2.0 FACILITY DESCRIPTION

2.1 Facility Location and Specifications

Pad 904 is located in the southeastern portion of the plant production area (Figure 2). The Pad was constructed, in August 1987, of hot bituminous pavement, three inches thick, which was placed over six inches of Class 6 course aggregate base which had been placed on regraded native soil (Figures 3 and 4). In-place soils were regraded and scarified prior to laying down the pavement for the pad. Soils removed from the pad area were pushed to the far west side of the pad. Pad 904 occupies a 129,505 square foot rectangular area, measuring 439 feet in the north-south direction and 295 feet in the east-west direction. Access to the Pad is provided from the northeast corner of the Pad. The perimeter of the Pad is fenced and identification/warning signs are placed on this fencing.

Pad 904 is sloped at approximately 0.7 percent to the northeast with run-off being intercepted by a ditch sloped to drain to the north. The ditch is located east of Pad 904 (Figure 3). No secondary containment structures were originally provided since the Pad was being used solely for containerized solid waste and no requirements existed in the regulations for secondary containments.

On June 6, 1988, six inch high asphalt berms were constructed around the west, north and east perimeter of Pad 904 (Figure 4). These berms were constructed in an attempt to collect surface water runoff samples from the Pad area. This berm also minimizes run-on. All Pondcrete storage has been done within the bermed area, designated Area A (Figure 4). The unbermed area, Area B, has been



ROCKY FLATS PLANT CONTROLLED AREA

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO
FIGURE 2

Figure 3

Figure 4

used for storage of other wastes and for operations related to Pad 904 activities (Figure 4).

It is anticipate that by December 1989 weatherproof shelters for the storage of pondcrete and saltcrete will be constructed and in use on Pad 904. These shelters will be modular, stressed membrane, relocatable structures which will require no excavation which will alter drainage off the Pad.

2.2 Facility Operation

2.2.1 Periods of Operation

Operation of Pad 904 as a containerized low-level mixed waste storage area for Pondcrete, a mixture consisting of solar evaporation pond clean-out sludge mixed with cement, was the result of:

- The lack of a low-level mixed waste disposal facility to accept the Pondcrete,

- The need for continued production of Pondcrete during solar pond closure activities,

- During the spring of 1987 storage of Pondcrete at the existing Pondcrete storage area (Pad 750) was approaching capacity.

For the reasons listed above, the Pad 904 location was selected for additional Pondcrete storage. This selection process included screening the area for the presence of pre-existing solid waste management units (SWMU's) by reviewing Appendix I of the November 1986 RCRA Part B Permit Application. This area was free of pre-

existing SWMU units. In the late summer of 1987, construction of Pad 904 began and waste was first received in September of 1987. The wastes stored on the Pad were described in the December 15, 1987 Revision 1 to the RCRA Part B Permit Application and consisted of the mixed low-level radioactive and hazardous wastes Pondcrete and Saltcrete. Saltcrete is a mixture of a forced evaporator salts and concrete. The majority of waste stored on the Pad has been Pondcrete.

Waste was first stored on the Pad for more than 90 days in December 1987 and waste is presently being stored. Accumulation of Pondcrete on Pad 904 temporarily ceased in May 1988 in reaction to a spill on the Pad. It is currently anticipated that no further accumulation of Pondcrete on Pad 904 will occur. Shipment of all Pondcrete on Pad 904 and cleanout of all Solar Evaporation Ponds is expected to be complete by October 1991 as stated in the "Agreement in Principle" signed by the DOE and CDH on June 28, 1989. These wastes will be disposed offsite at the Nevada Test Site (NTS), an approved RCRA facility.

2.2.2 Maximum Waste Inventory

The maximum Pondcrete and Saltcrete storage capacity of Pad 904 Area A is 6,136 triwall and 102 metal boxes of waste, accounting for approximately 103,464 cubic feet of waste (10,346,400 pounds, assuming a density of 100 pounds per cubic foot).

The current quantities of waste stored on Pad 904 Area A, as of September 1989, are as follows:

	Quantity	Volume cubic feet
Pondcrete,Triwall Boxes (15 cubic feet each)	4,491	67,365
Pondcrete 4ft x 4ft x 7ft Metal Boxes	102	11,424
Saltcrete Triwall Boxes (15 cubic feet each)	1,645	24,675
		103,464

The current quantities of waste stored on Pad 904 Area B, as of September 1989, are as follows:

	Quantity	Volume cubic feet
Roaster Oxide Drums	353	4,308
Composite Chips (ft x 4ft x 7ft metal Boxes)	23	2,576
Composite Chips (2ft x 4ft x 7ft plywood Boxes)	1	56
Sanitary Sludge (2ft x 4ft x 7ft Metal Boxes)	313	8,700
Cemented Sludge Half Box	1	30
Drilling Soil (4ft x 4ft x 7 ft Metal Boxes)	1	112
S & W Soil (4ft x 4ft x 7 ft Metal Boxes)	2	224
Miscellaneous Materials (2ft x 4 ft x 7ft Plywood Boxes)	9	504
Miscellaneous Materials (4ft x 4ft x 7ft Metal Boxes)	3	336
		16,846

These wastes total 16,846 cubic feet of other wastes for a total of 1,684,600 pounds of waste stored in Area B, assuming a density of 100 pounds per cubic foot.

All future production of Pondcrete is anticipated to be shipped offsite without a storage period. Therefore, no more than the current inventory of Pondcrete is expected to be present on the Pad.

2.2.3 Types of Waste Managed

Pad 904 is used to store sanitary wastewater treatment plant (Building 995) sludge, and miscellaneous materials which are stored in cargo containers in Area B in addition to Pondcrete and Saltcrete which is stored directly on the Pad in Area A. This closure plan addresses only the mixed low-level radioactive and hazardous solid waste stored on the Pad in Area A. Low-level mixed wastes are defined as radioactive wastes with transuranic activity of less than 100 nanocuries per gram mixed with hazardous wastes. Transuranic compounds are those compounds with atomic number greater than uranium.

Table 1 identifies the EPA Hazardous Waste Numbers associated with Pondcrete in the RCRA Part A Permit Application. The maximum concentrations of any hazardous constituents and radionuclides identified in laboratory analyses are also presented. The analyses whose results are presented were conducted on both cured (hardened)

TABLE 1
PONDCRETE HAZARDOUS WASTE NUMBERS,
MAXIMUM CONCENTRATIONS OF HAZARDOUS CONSTITUENTS
AND RADIONUCLIDES

EPA Waste Number From Part A	Description	Maximum Concentration Identified
o D003	Reactivity	8.2 Milligrams per Liter (mg/l) of Cyanide contained in Pondcrete, Pondcrete Never Found to be Reactive Based on Evolution of Gas or Other Definitions of Reactivity.
o D005, D007, D008, D011	Extraction Procedure (EP) Toxicity for Barium, Chromium, Lead, and Silver	Pondcrete Never Found to be EP Toxic
o F001, F002	Spent Halogenated Solvents (SHS) Tetrachloroethylene (Perchloroethylene) Methylene Chloride (Dichloromethane)	Detailed Below by Individual Compound 0.073 milligrams per kilogram (mg/kg) 0.035 mg/kg
o F003	Spent Non-Halogenated Solvents Acetone	No Identification of Spent Non-Halogenated Solvents 0.180 mg/kg
o F024	Production Waste of Chlorinated Aliphatic Hydrocarbons	No Identification of Chlorinated Aliphatic Hydrocarbons in Pondcrete
o U002	Acetone	0.180 Milligrams per Kilogram (mg/kg)
o U080	Methylene Chloride	0.035 mg/kg
o U209	1,1,2,2-Tetrachloroethane	0.160 mg/kg

TABLE 1
PONDCRETE HAZARDOUS WASTE NUMBERS,
MAXIMUM CONCENTRATIONS OF HAZARDOUS CONSTITUENTS
AND RADIONUCLIDES
(Continued)

EPA Waste Number From Part A	Description	Maximum Concentration Identified
*	Methyl Ethyl Ketone	0.023 mg/kg
*	Bis(2-ethylhexyl)-phthalate	0.152 mg/kg

Radionuclides**	Description	Maximum Identified Activity
	Plutonium-239	1800 ± 100 pCi/g
	Americium-241	1600 ± 100 pCi/g
	Uranium-233,234	60 ± 11 pCi/g
	Uranium-238	66 ± 12 pCi/g

* Not listed in the Part A

** Radionuclides are not considered hazardous constituents nor hazardous waste under RCRA.

and uncured Pondcrete in 1986, 1987 and 1988. Based on the information presented in Table 1, many of the Hazardous Waste Number listings for Pondcrete in the RCRA Part A Permit are erroneous. The waste either does not have all of the characteristics identified, or it has not been found to contain the compound associated with the Hazardous Waste Number.

Table 2 identifies the EPA Hazardous Waste Numbers associated with Saltcrete in the RCRA Part A Permit Application. The maximum concentrations of any hazardous constituents identified in laboratory analyses are also presented. The results presented in Table 2 are for analyses conducted on Saltcrete in 1986 and 1988. Based on the information presented in Table 2, many of the Hazardous Waste Number listings for Saltcrete in the RCRA Part A Permit are erroneous. The waste either does not have all of the characteristics identified, or it has not been found to contain the compound associated with the Hazardous Waste Number. Saltcrete is not subject to the land-ban requirements as identified by Toxicity Characteristic Leaching Procedure (TCLP) tests.

2.2.4 Waste Process Description

Production process descriptions for Pondcrete and Saltcrete can be found in Section D of the RCRA Part B Permit. These are attached as Appendix A. A brief summary of these descriptions is given. Pondcrete is a solid material resulting from combining Solar Pond sludge or sediment with Portland Cement. The production of Pondcrete occurs near the Solar Ponds adjacent to Building 788. This material was mixed and placed in tri-wall fiberboard boxes, lined with 0.011 inch thick plastic. Each box contains approximately 15 cubic feet of processed waste. The boxes were banded to pallets for structural integrity and ease of

TABLE 2
SALTCRETE HAZARDOUS WASTE NUMBERS AND MAXIMUM CONCENTRATIONS OF HAZARDOUS CONSTITUENTS AND RADIONUCLIDES

EPA Waste Number From Part A	Description	Maximum Concentration Identified
o D002	Corrosivity	Saltcrete Never Found to be Corrosive
o D003	Reactivity	0.97 Milligrams per Kilogram (mg/kg) of Cyanide, 13 mg/kg of Sulfide, Saltcrete Never Found to be Reactive Based on Evolution of Gas or Other Definitions of Reactivity
o D005, D007, D008, D011	EP Toxicity for Barium, Chromium, Lead, and Silver	Saltcrete Never Found to be EP Toxic
o F001, F002	Spent Halogenated Solvents (SHS) Methylene Chloride	Detailed Below by Individual Compound 0.080 mg/kg
o F003	Spent Non-Halogenated Solvents Acetone	Detailed Below 0.380 mg/kg
o F004	Spent Non-Halogenated Solvents	Never Detected Listed Spent Non-Halogenated Solvents
o F005	Spent Non-Halogenated Solvents Methyl ethyl Ketone Toluene	Detailed Below 0.070 mg/kg 0.026 mg/kg
o F024	Production Waste of Chlorinated Aliphatic Hydrocarbons	No Identification of Chlorinated Aliphatic Hydrocarbons in Waste
o U002	Acetone	0.380 mg/kg
o U044	Chloroform	Not Detected

TABLE 2
PONDCRETE HAZARDOUS WASTE NUMBERS AND
MAXIMUM CONCENTRATIONS OF HAZARDOUS CONSTITUENTS
AND RADIONUCLIDES
(Continued)

EPA Waste Number From Part A	Description	Maximum Concentration Identified
o U080	Methyene Chloride	0.020 mg/kg
o U109	1,2-Diphenylhydrazine	Not Detected
o U159	Methyl Ethyl Ketone	0.070 mg/kg
o U220	Toluene	0.026 mg/kg
o *	Benzene	0.026 mg/kg

Radionuclides**	Description	Maximum Identified Activity
	Plutonium-239	160 ± 10 pCi/g
	Americium-241	88 ± 4 pCi/g
	Uranium-233,234	25 ± 10 pCi/g
	Uranium-238	88 ± 18 pCi/g

* Not listed in the Part A

** Radionuclides are not considered hazardous constituents nor hazardous waste under RCRA.

transportation. The boxes are transported into Building 788 to allow the Pondcrete to harden. Once the material has hardened the Pondcrete is transported to Pad 750 or 904 to await offsite disposal. Currently Pondcrete is placed in four foot by two and one half foot by seven foot polyethylene lined 3/4-inch thick plywood boxes following a process similar to that described above.

Saltcrete is a material similar in nature and manufacture to Pondcrete. Saltcrete is manufactured in Building 374 from salts which remain as a result of the evaporation of liquid process waste. This material was also placed in tri-wall fiberboard boxes, lined with 0.011 inch thick plastic, and allowed to harden. Once the material has hardened the Saltcrete is transported to Pad 750 or 904 to await offsite disposal. Currently Saltcrete is placed in four foot by two and one half foot by seven foot polyethylene lined 3/4-inch thick plywood boxes following a procedure similar to that described above.

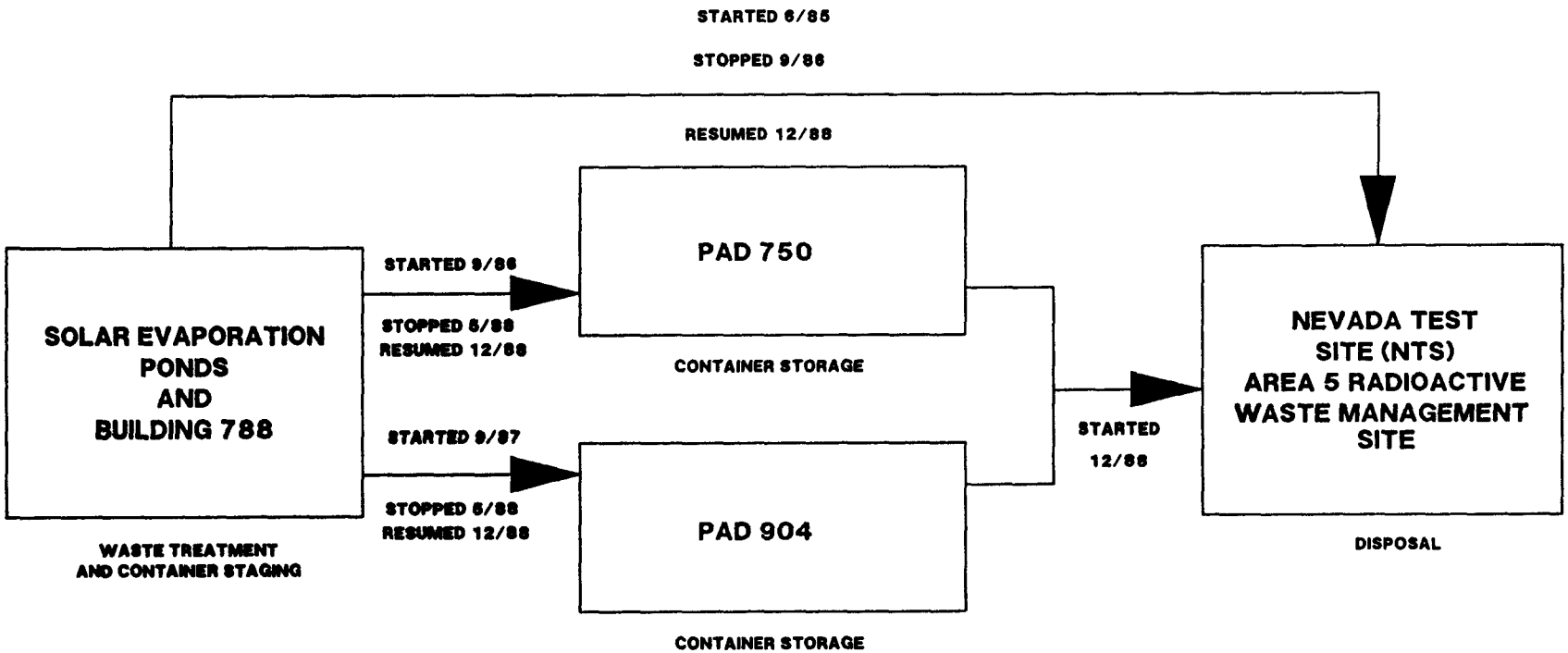
Prior to May 23, 1988, all Pondcrete waste on Pad 904 was stored in groups of 72 boxes each. Boxes of waste were stacked three high in each group, and each group of 72 boxes was covered with tarpaulins of 100% polyester basecoat weave. These tarpaulins met military specification MIL-C-44-103 with a projected lifetime of three years. These tarpaulins were intended to provide protection from the weather.

On May 23, 1988, a spill of Pondcrete occurred at Pad 904. The existence of unhardened Pondcrete in the waste boxes led to the deformation of several boxes. The deformed boxes caused the stacks to become unstable and required that some waste be unstacked to prevent possible spills and other accidents.

Activities related to unstacking the Pondcrete boxes began shortly after identification of the problem of box deformation. While unstacking the boxes, one box fell off the forklift onto the asphalt of Pad 904. The plastic liner failed from the impact of the fall, and approximately 0.25 cubic feet of Pondcrete spilled onto the asphalt of Pad 904. Response to this spill required the implementation of the RCRA Contingency Plan, and was therefore reported to CDH and EPA in the RCRA Contingency Plan Implementation Report No. 88-001. This spill was followed by other, similar spills at Pad 904.

Investigations related to the above spills identified inadequate quality control and inadequate inspection in the production of Pondcrete and subsequent destabilization of the waste form. Production of Pondcrete ceased on May 23, 1988, pending resolution of the problems, and more detailed inspections of the wastes stored on Pad 750 followed. These inspections identified approximately 25 percent of the Pondcrete boxes on Pad 904 to be of poor quality (ie, containing unhardened Pondcrete in at least a portion of the volume). Severely deformed boxes of waste were transferred into four foot by four foot by seven foot metal boxes or to Building 788 to await reprocessing.

Figure 5 presents the waste handling, treatment, storage and disposal process of the Pondcrete during the last four years. Between June 1986 and September 1986, Pondcrete produced as a result of the closure activities at the Solar Evaporation Ponds was shipped directly to the Nevada Test Site (NTS). In September of 1986 Pondcrete was identified as a mixed waste. NTS was not permitted as a low-level mixed waste disposal facility so Pondcrete shipments ceased. Pondcrete produced had to be stored on-site awaiting a final resolution to the problem of disposal.



STABILIZATION, CONTAINERIZATION, STORAGE, AND DISPOSAL PROCESS

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO
FIGURE 5

The original on-site storage area for Pondcrete was Pad 750. During the spring of 1987 storage of Pondcrete at the existing storage area (Pad 750) was approaching capacity and the Pad 904 location was selected for additional Pondcrete storage.

As of September 1989, the proposed weekly shipment schedule for Pondcrete from the Plant to the NTS is as follows:

- 48 plywood boxes from the Pads,
- 30 plywood boxes from the reprocessing area, and
- 34 plywood boxes directly from the processing area.

2.2.5 Monitoring and Containment Systems

Monitoring of Pad 904 has consisted of a combination of weekly inspections and regular monitoring of various media. Weekly inspections consist of walking aisles of the Pad and looking for leaking boxes, missing tarpaulins or other obvious problems with the Pondcrete storage. Any problems noted, such as missing tarpaulins, are corrected. Monitoring of the various media which may be impacted by operations at the Pad are discussed in detail below.

2.2.5.1 Air monitoring and containment

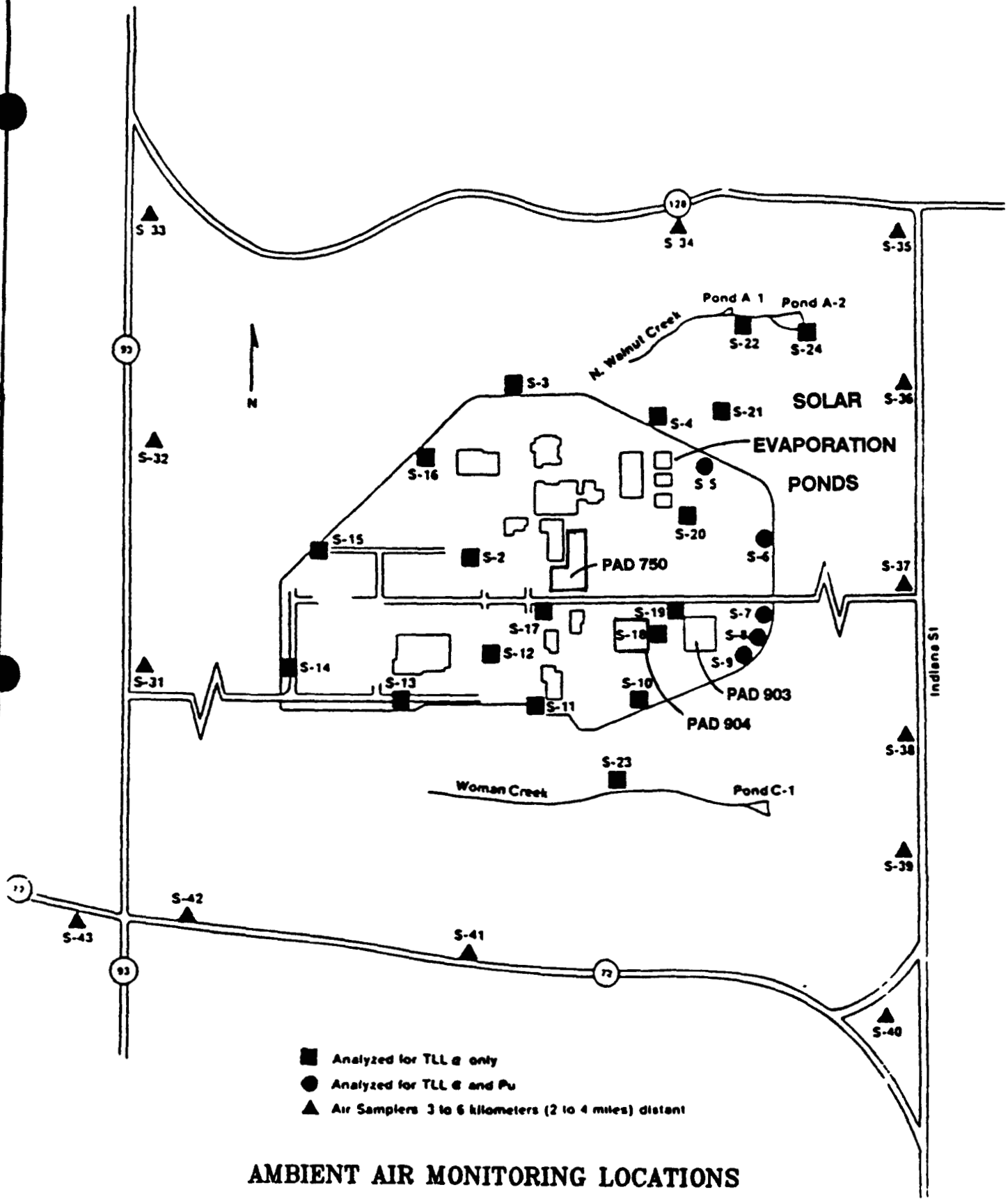
Air Monitoring

Ambient air samplers are located on the Rocky Flats plantsite, at the Plant perimeter (at a distance of approximately two to four miles from the Plant's center), and in surrounding communities.

This monitoring program is known as the Radioactive Ambient Air Monitoring Program (RAAMP). This section addresses the RAAMP samplers located on the plantsite (Figure 6), as well as High-Volume (Hi-Vol) portable air samplers. Of particular interest are the samplers located near Pad 904, designated S-7, S-8, S-9, S-10, S-12, S-17, S-18 and S-19. The samplers designated S-7, S-8 and S-9 are located in the predominant downwind direction of Pads 903 and 904; the samplers designated S-10, S-18 and S-19 are located in the predominant downwind direction of Pad 904 and in the predominant upwind direction of Pad 903; and, the samplers designated S-12 and S-17 are located in the predominant upwind direction of Pads 903 and 904.

The RAAMP samplers operate continuously at an approximate volumetric flow rate of 25-35 cubic feet per minute (ft3/min) collecting air borne particles on a eight-inch by ten-inch fiberglass media. Manufacturer's test specifications rate this filter media to be 99.42 percent efficient for collection of particulates in the 0.01 to 1.0 micron range, as characterized by the median aerodynamic diameter (Wedding and Carney, 1978; Wedding et al, 1984; and Schleicher and Schuell, Inc. 1982). The maximum sized particles these have been found to collect is approximately 30 microns in diameter. This collection range and efficiency gives an excellent coverage of the total size range of respirable particles as discussed in applicable EPA publications (EPA, 1982 and 1985).

All RAAMP sample filters are collected biweekly and analyzed for total long-lived alpha (TLL Alpha) activity. If the TLL Alpha activity for a filter exceeds the Plant Screening Guide of .01 picocuries per cubic meter (pCi/m3) a specific plutonium analysis is performed. The Plant Screening Guide is more conservative than



AMBIENT AIR MONITORING LOCATIONS

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO
FIGURE 6

the DOE Derived Concentration Guide of .02 pCi/m3 for plutonium inhalation by members of the public. Of the air sampler locations listed above, sampling sites S-7, S-8 and S-9 are routinely analyzed for both TLL Alpha and plutonium.

In addition to the RAAMP monitoring in the vicinity of Pad 904, Hi-Vol portable air samplers have been employed at Pad 904. Within a few hours following the May 23, 1988 Pondcrete spill incident two Hi-Vol portable air samplers were moved to the Pad. One sampler was located in the center of the Pad and the second sampler was located on the eastern edge of the Pad, in the predominant downwind direction. These samplers were operated continuously on Pad 904 until approximately April 1989. The filters from these air samplers were analyzed for both TLL alpha and plutonium. Analytical results available as of April 1989 indicated that concentrations of plutonium were found to be below the Rocky Flats Plant screening level of 0.01 pCi/m3 at both the RAAMP and Hi-Vol portable samplers operated near Pad 904.

Air Containment

The RCRA Contingency Plan was implemented to abate any potential airborne transport related to Pondcrete spills. Generally this plan involved transferring the contents of the failed container and the spilled Pondcrete into a four foot by four foot by seven foot metal container and transferring this container to an indoor area or another location on the Pad for temporary holding while awaiting reprocessing. The location of the Pad where the Pondcrete had spilled was then cleaned by washing with water using brooms to remove Pondcrete from crevices in the asphalt. Wash water was collected using a wet vacuum cleaner. This liquid was then

transferred to the Pondcrete processing area for reprocessing into Pondcrete.

2.2.5.2 Surface water monitoring and containment

Surface Water Containment

Pad 904 construction is described in Section 2.1. The Pad originally consisted of only asphalt with no runoff containment berms. Berms were constructed on the west, north and east sides of Pad on June 6, 1988, following a spill of Pondcrete (Figures 3 and 4). The height of the berm is six inches. The purpose of the berm is that of collecting storm runoff rather than spill containment. The berm was constructed of hot bituminous pavement and as such is not completely impermeable to water. The berms are believed to be inadequately sealed to the Pad to prevent water from flowing under the berms and off the Pad. The Pad surface and inside the berm is approximately 107,600 square feet (ft^2), while the Pad area outside the berm is about 19,200 ft^2. All Pondcrete is stored within the bermed area (Area A).

As shown on Figure 4, the Pad surface slopes to the north and east at 0.7 percent respectively. Because of this slope, water tends to accumulate along the north berm and in the northeast corner of the Pad adjacent to the berm.

The six-inch high berm could store approximately 5120 cubic feet (ft^3) of water uniformly distributed along the north berm. This volume of runoff translates to a storm of about 1.0 inches at a CN of 95 and average initial abstractions. The average annual recurrence interval 24-hour storm for this 1.0-inch rainfall is less than 2 years (DRCOG, 1969), and most likely would occur on the

average at least once every year. Therefore, the 6-inch high berm along the west, north and east sides of Pad 904 may not be effective in retaining even moderate storm events.

In order to minimize runoff overtopping the berms, a mobile tank with pumping equipment to collect ponded water from the Pad was moved to the Pad. The mobile and associated pumping equipment was added to the RCRA Part B Permit Application for Low-Level and Mixed Waste as a 90-day storage area. The water which is collected is transported to the forced evaporator in Building 374 for treatment or to the Tank 231 Tank complex for storage prior to evaporation in Building 374.

Surface Water Monitoring

Sampling of runoff water from Pad 904 began on February 12, 1988. Grab samples were collected where runoff exited the Pad at its northeast corner until after June 6, 1988 when samples were also collected from water ponded behind the newly constructed berm. The water samples were routinely analyzed for gross alpha, gross beta, nitrate-nitrogen and dissolved solids concentrations. One sediment sample that had been contaminated by runoff from a Pondcrete spill (July 22, 1988) was also collected and analyzed for gross alpha and gross beta activity. Specific isotopes (plutonium, americium and uranium) have occasionally been analyzed in water samples. Detailed discussions of the results of these analyses are presented in Section 2.2.6.3.

2.2.5.3 Soil monitoring and containment

Soil Monitoring

April 7, 1987 Soil Sampling

Because Pad 904 is located adjacent to Pad 903, the largest source of plutonium release to the environment at the Rocky Flats Plant (Rockwell, 1987), soil samples were collected prior to the construction of Pad 904 to assess the pre-existing concentrations of plutonium-239. Four soil samples were collected from a 125,000 square foot (ft^2) area on April 7, 1987 (Figure 7). The samples were taken from the "undisturbed" soils to a total depth of approximately two inches in the area where Pad 904 was to be constructed. Samples were collected using the Rocky Flats sampling tool which extracts a sample 10 cm x 10 cm on a side and five cm deep.

Plutonium-239 concentrations for the four samples collected on April 7, 1987 ranged from 0.03 pCi/gm to 4.2 pCi/gm (Table 3). These concentrations are generally above fallout levels (0.2 pCi/gm) (USEPA 1986) and indicate some plutonium contamination was present at the Pad 904 location prior to construction of the Pad. While only limited data are available for soil in the Pad 904 area, it appears that plutonium concentrations increase toward the east, in the direction of Pad 903, which is the probable source for the elevated plutonium-239 concentrations in soil (Figure 7).

August and September, 1987 Soil Sampling

Soil at Pad 904 was resampled in August and September, 1987 when the Pad was under construction. As a result of Pad construction,

Figure 7

TABLE 3

SUMMARY OF SOIL CHEMICAL DATA AT AND NEAR 904 PONDCRETE STORAGE AREA

SAMPLE DATE	SAMPLE DESIGNATION 1)	Am-241 (pCi/gm)	Pu-239 (pCi/gm)	Pu (Total) (pCi/gm)	U (Total)	U-234 (pCi/gm)	U-238 (pCi/gm)	NO3-N (ppm)
	87-903NW							
April 7, 1987	87-903NE	-- 2)	0 03	--	--	--	--	--
	87-903SW	--	1 8	--	--	--	--	--
	87-903SE	--	0 12	--	--	--	--	--
		--	4 2	--	--	--	--	--
	W-903-1							
Aug./Sept. 1987	W-903-1	--	9 15+/-0 88	--	--	--	--	--
	W-903-2	--	8 09+/-0.66	--	--	--	--	--
	W-903-2	--	Data Not Valid	--	--	--	--	--
	W-903-3	--	18 82+/-1 75	--	--	--	--	--
	W-903-3	--	13.95+/-1 22	--	--	--	--	--
	W-903-4	--	16 93+/-1.51	--	--	--	--	--
	W-903-4	--	67 16+/-8 08	--	--	--	--	--
		--	66 62+/-5.38	--	--	--	--	--
	1							
May 26, 1988	2	--	0.24+/-0 0028	--	--	0.95+/-0 10	0 98+/-0 10	14
	3	--	2.28+/-0.22	--	--	1 12+/-0 12	1 08+/-0.12	850
	4	--	--	--	--	--	--	7
	5	--	--	--	--	--	--	14
	6	--	0.23+/0.022	--	--	0 72+/-0.08	0 67+/-0 07	8
		--	0.26+/-0.026	--	--	1.11+/-0.18	1.01+/-0 11	140
October 24, 1988	1	0 14+/-0.01 3)	--	3 7+/-0 2	2 3	--	--	--
	2	1.49+/-0.08	--	2 8+/-0 2	1 9	--	--	--
	3	23.9+/-1.03	--	0 3+/-0 1	2.4	--	--	--
	4	3 63+/-0.15	--	0 2+/-0 1	2 7	--	--	--
	5	0 23+/-0.01	--	16+/-1	3.7	--	--	--
	6	0 35+/-0.02	--	34+/-1	3 1	--	--	--
	7	--	--	4 0+/-0.2	3 4	--	--	--
	8	--	--	3 3+/-0.1	4 0	--	--	--
	Reagent Blank	0.23+/-0.03	--	--	--	--	--	--

1) Estimated Sample Locations Shown on Figure

2) -- No Analyses For Indicated Variable

3) Counting Error (+/-) at 95% Confience Interval Shown When Reported By Laboratory

the vegetation and top six to 12 inches of soil in the Pad 904 area were removed. Samples were then collected from eight sites (Figure 8). The samples were collected using the Rocky Flats sampling tool described above. Field notes recorded at the time of sampling reported that the soil material was extremely rocky, and recovery from the tool for each sample was low. Also, the soil was wet as a result of a rainfall event which had occurred the previous night. The samples were analyzed for plutonium-239 concentrations. Plutonium-239 concentrations for the eight soil samples collected in August and September, 1987 ranged from about 8 to over 67 pCi/gm (Table 3). The areal distribution of plutonium-239 concentrations in these samples were similar to those of the samples collected on April 7, 1987, with concentrations increasing in the direction of Pad 903 (Figure 8). However, the plutonium-239 concentrations found in soil collected in August and September 1987 were more than an order of magnitude higher than the plutonium-239 concentrations found in soil collected on April 7, 1987.

The results of sampling activities in April 7, 1987, and in August and September 1987, seem to indicate that relatively clean soil materials had been laid down over already contaminated soil materials in the area of Pad 904. Covering plutonium-contaminated soils with clean soils was a practice at the Rocky Flats Plant during the late 1960's and early 1970's. This practice was instituted to minimize the resuspension and off-site transport of plutonium contaminated soil particles. Also, during that time period, intense activities were underway near Pad 903, with drums containing plutonium being reprocessed and repackaged.

Figure 8

May 26, 1988 Soil Sampling

In response to a May 23, 1988 Pondcrete spill on Pad 904, six soil samples were collected on May 26, 1988 from four sites immediately adjacent to the eastern and northern edges of Pad 904, and two sites chosen as "background" for purposes of analyzing for nitrate as nitrogen, plutonium-239 and uranium-234, 238 concentrations (Figures 9, 10, 11 and 12, respectively).

The four samples collected for evaluating contamination (Sites 1, 2, 5 and 6 presented on Figure 9 through 12) were collected from gravel shoulder of Pad 904 at a depth of approximately three-inches. These sampling sites were selected based on staining on the asphalt of Pad 904 which indicated an area where runoff had exited the as-yet unbermed Pad 904.

Analytical results of the soil samples collected on May 26, 1988 are presented in Table 3. Nitrate concentrations ranged from 7 mg/kg to 850 mg/kg with the highest concentrations found in soil associated with the center of the eastern and northern edges of the Pad (Figure 9). Plutonium-239 concentrations ranged from 0.23 +/- 0.022 to 2.28 +/- 0.22 pCi/gm with the higher concentrations being found in soil associated with the center of the eastern edge of the Pad (Figure 10). Uranium-234 concentrations ranged from 0.72 +/- 0.08 to 1.12 +/- 0.12 pCi/gm with higher concentrations found in soils associated with the center of the eastern and northern edges of the Pad (Figure 11). Uranium-238 concentrations ranged from 0.67 +/- 0.07 to 1.08 +/- 0.12 pCi/gm with a slight increase in concentrations similar to those found for nitrate concentrations (Figure 12).

FIgure 9

Figure 10

Figure 11

Figure 12

October 24, 1988 Soil Sampling

Soil sampling done on October 24, 1988 provides additional evidence that the native soil in the vicinity of Pad 904 was buried beneath a layer of debris and imported soils. This soil sampling was conducted west of Pad 904, with the eight soil sampling locations presented on Figures 13 through 15. Analyses were for americium-241, total plutonium and total uranium. The reason for this sampling was the possible construction of a new building related to Pondcrete operations immediately west of Pad 904. Up to six inches of overlying debris and soil were penetrated at the eight sampling sites prior to reaching the "original" ground surface. The original ground surface was sampled and submitted for analysis.

Analytical results related to the October 24, 1988 soil sampling are presented in Table 3. These results indicate that americium-241, total plutonium and total uranium concentrations in soil were present above fallout concentrations, most likely due to activities at Pad 903. Americium-241 concentrations were found to range from 0.14 +/- 0.01 to 23.9 +/- 1.03 pCi/gm (the reagent blank was found to have a concentration of 0.23 +/- 0.03 pCi/gm) with an increase in concentrations being evident away from the Pad in a westerly, upwind, direction (Figure 13). Total plutonium concentrations were found to range from 2.8 +/- 0.2 to 34 +/- 1 pCi/gm with an increase in concentrations found to be similar to americium-241 concentrations (Figure 14). Total uranium concentrations were found to range from 1.9 to 4 pCi/gm with a slight decrease in concentrations being evident away from the Pad in a northwesterly, upwind, direction (Figure 15).

Figure 13

Figure 14

Figure 15

Soil Containment

There have been no reported spills to soil in the Pad 904 area and as a result soil containment has not been necessary.

2.2.5.4 Groundwater monitoring and containment

Groundwater Monitoring

Although groundwater monitoring is not specifically required for container storage areas, groundwater monitoring of the Pad 904 Area is provided as part of on going Environmental Restoration Program. These programs are: Remedial Investigations (RI's) for CERCLA sites at the Hillside 881, Pad 903, Mound, and East Trenches; and various RCRA Closure activities.

Specifically, this section addresses the groundwater monitoring locations in the vicinity of Pad 904 (Figure 16). Of particular interest are the 14 monitoring wells located near Pad 904, wells; 23-86, 24-86, 25-86, 26-86, 33-86, 61-86, 4-87BR, 5-87BR, 9-87BR, 10-87BR, 15-87, 16-87BR, 44-87 and 45-87BR. Boring logs for these wells are presented in Appendix B.

The following sections present a geologic and hydrogeologic model of the Pad area.

2.2.5.4.1 Regional Alluvial Geology

The alluvial geology in the vicinity of Pad 904 consists mainly of Rocky Flats Alluvium and disturbed ground unconformably overlying bedrock. The Rocky Flats Alluvium is topographically the highest and oldest member of six alluvial deposits in the vicinity of the

Figure 16

plant (Figure 17). The Rocky Flats Alluvium occurs at elevations between 6,000 feet and 5,930 feet above sea level in the immediate area of Pad 904.

The Rocky Flats Alluvium is a Quaternary alluvial complex derived from the Colorado Front Range. It is comprised of poorly sorted cobbles, gravels, sands, silts and clays with some boulders, and is cemented in some areas by caliche (Rockwell, 1986). The thickness of the Rocky Flats Alluvium is variable due to deposition on an erosional surface and recent erosional processes. It is thickest west of the Plant where less has been eroded, and thinnest to the east of the Plant (Rockwell, 1988). The Rocky Flats Alluvium material has been partially removed by erosion and the resulting drainages repeatedly infill with more recent sediments.

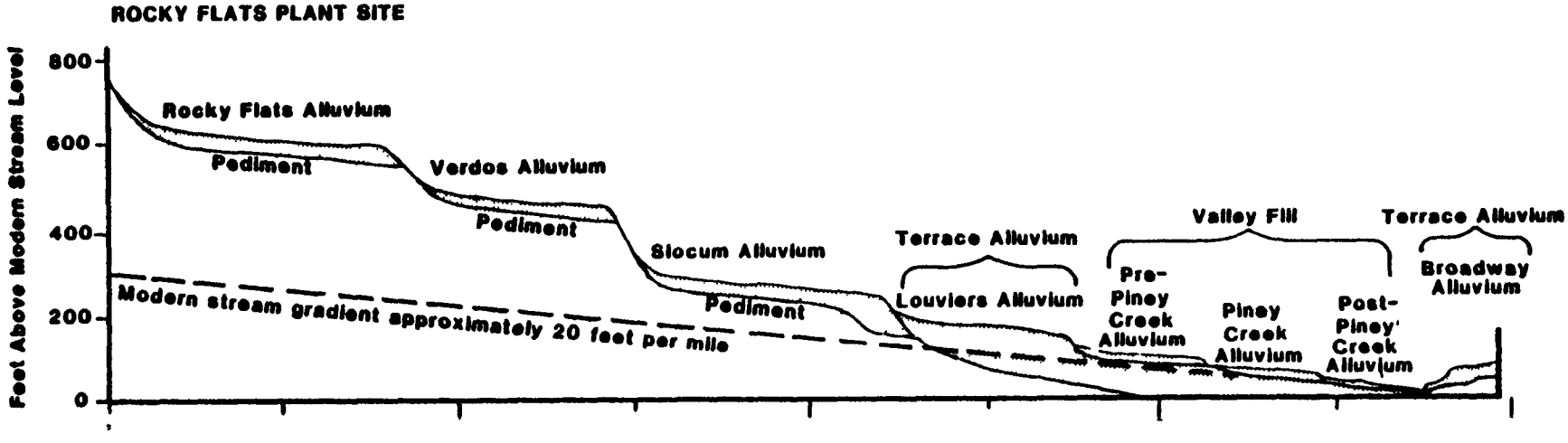
Areas of disturbed ground caused by construction of roads, buildings, pads and other Plant activities is also found in the area of Pad 904. This disturbed ground is reworked Rocky Flats Alluvium in the Pad area and is generally described as unconsolidated clay, silt, sand, gravel and pebbles. The materials are very poorly sorted with fragments of claystone and cement rubble and display no bedding. (Rockwell, 1988).

2.2.5.4.2 Regional Bedrock Geology

Bedrock units underlying the Plant consist of the Arapahoe and Laramie Formations (Rockwell, 1988). Because of the thickness and low permeability of the upper Laramie, it is generally considered to be the base of the hydrogeologic system which could be affected by Plant operations (Rockwell 1988).

WEST

EAST



(after. Scott, 1960)

GENERALIZED GEOLOGIC CROSS SECTION

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO
FIGURE 17

Arapahoe Formation

The Arapahoe Formation is a fluvial deposit that consists of claystones with interbedded lenticular sandstones and siltstone. Contacts between these lithologies are both sharp and gradational. The claystones are poorly indurated, silty, and contain up to 15 percent organic material. Weathering has penetrated as much as 40 feet into bedrock. The weathered claystone is light olive gray, blocky, slightly fractured, and has iron staining as mottles along bedding planes and fractures (Rockwell, 1986a).

Sandstones in the Arapahoe Formation are very fine to medium grained, with approximately 15 percent silt and clay. The sandstones are lenticular, discontinuous, and stratigraphically complex. The sand grains are subangular to subrounded and are predominantly quartzose with 10 percent lithic fragments. The sandstones are poorly to moderately cemented and exhibit ripple marks, load casts, and planar, angular, and trough crossbedding.

Arapahoe Formation siltstones exhibit the same coloration, constituents, bedding characteristics, and sedimentary structures as the sandstones (Rockwell, 1988).

The general bedrock geologic structure of the region is north striking sedimentary beds with dips to the east away from the Front Range Monocline. Dips are on the order of 3 to 7 degrees beneath the Plant.

There are believed to be no major faults cutting through the Arapahoe Formation in the vicinity of the plant. (Rockwell, 1986).

2.2.5.4.3 Site Alluvial Geology

The alignments of three cross-sections (A-A', B-B' and C-C') are presented on Figure 16. Appendix B presents the lithologic logs that were used to develop the three geologic cross-sections.

A north to south cross-section (A-A') through the area of Pad 904 indicates that approximately 10 to 20 feet of Rocky Flats Alluvium (Qrf) underly Pad 904 (Figure 18). The alluvium appears to be completely eroded approximately 150 and 900 feet north of Pad 904, where surface drainages exist. South of Pad 904 the Rocky Flats Alluvium attains a maximum thickness of approximately 40 feet and then rapidly reduces in thickness as it enters the north flank of the Woman Creek valley. Throughout the area which cross-section A-A' transects the Rocky Flats Alluvium is underlain by subcropping claystones (Ka) and isolated subcropping siltstones/sandstones (Kass) of the Arapahoe Formation.

An east to west cross-section (B-B') through the area of Pad 904 indicates that approximately 10 feet of Rocky Flats Alluvium (Qrf) underly the Pad (Figure 19). The alluvium appears to maintain a thickness of 10 to 20 feet. This alluvium appear to be underlain by claystones (Ka) and isolated subcropping siltstones/sandstones (Kass) of the Arapahoe Formation along the entire length of the cross-section.

A north to south cross-section (C-C') through the area of Pad 904 indicates that approximately 10 feet of Rocky Flats Alluvium (Qrf) underly the Pad (Figure 20). The alluvium appears to maintain a thickness of five to 15 feet with some reduction in thickness being noted along the southern end of the cross-section as the alluvium enters the north flank of the Woman Creek valley. Throughout the

area which cross-section C-C' transects the Rocky Flats Alluvium is underlain by claystones (Ka) of the Arapahoe Formation.

2.2.5.4.4 Site Bedrock Geology

A north to south cross-section (A-A') through the area of Pad 904 indicates that an approximately 100 foot thick sandstone/siltstone unit of the Arapahoe Formation is present as a subcrop at a depth of approximately 10 feet directly below Pad 904 (Figure 18). This unit appears to be dipping to the southeast at approximately six degrees.

An east to west cross-section (B-B') through the area of Pad 904 supports the existence of the 100 foot thick sandstone/siltstone unit of the Arapahoe Formation presented above (Figure 19).

A north to south cross-section (C-C') through the area of Pad 904 indicates that sandstone/siltstone unit of the Arapahoe Formation maybe present at a depth of approximately 85 feet below Pad 904 (Figure 20). Based on cross-section C-C', this unit is vertically separated from the Pad by approximately 10 feet of Rocky Flats Alluvium and 75 feet of Arapahoe claystone.

2.2.5.4.5 Site Alluvial Hydrogeology

The alluvial aquifer potentiometric surface slopes away from Pad 904 toward the north, east and south (Figure 21). Groundwater flow in the alluvial aquifer appears to be strongly influenced by topography and the configuration of the base of weathering in the Arapahoe Formation (Rockwell, 1989).

The alluvium potentiometric map was developed using groundwater monitoring data collected on April 4, 11 and 18, 1988. Appendix C presents hydrographs for alluvial wells which are located along the cross-sections A-A', B-B' and C-C'.

Groundwater elevation information for alluvial wells presented in Appendix C suggests that groundwater levels have remained relatively stable in wells 4-87, 10-87, 15-87, 26-86 and 61-86 (variance within one to six feet) and have dropped below the lowest screened interval during most of the period of record in wells 24-86 and 44-87 (variance of approximately one to two feet caused dry wells). Based on the contour interval of the alluvium potentiometric map of 10 feet the alluvial groundwater elevation variations with time should not significantly effect the general slope of the potentiometric surface presented on Figure 21.

Previous alluvial aquifer potentiometric maps for the first through fourth quarters of 1988 (Rockwell, 1989) indicated that alluvial aquifer flow directions and gradients remain fairly constant throughout the year. Therefore, the potentiometric surface presented on Figure 21 is thought to adequately represent alluvium hydrogeologic conditions near Pad 904. Areas of unsaturated surficial materials are present north of Pad 904 near wells 33-86 and 38-87. These unsaturated surficial materials may represent areas where bedrock is very near the surface and acts as a no flow boundary or where building footing drains dewater the local alluvial aquifer.

Based on the information presented on the alluvium potentiometric map and cross-sections A-A', B-B' and C-C' the following can be stated about groundwater monitoring in the Pad 904 area.

- o Groundwater flowing south from Pad 904 may be monitored using information collected from wells 10-87 and 44-87.

- o Groundwater flowing east from Pad 904 may be monitored using information collected from wells 10-87 and 15-87, and

- o Groundwater flowing north from Pad 904 will most likely be discharged to the headwaters of South Walnut Creek prior to being intercepted by well 33-86.

Analyses of the alluvium potentiometric data indicates that water in the alluvial aquifer in the vicinity of Pad 904 flows; toward the south and southeast at a rate of about 5.26×10^{-3} ft/day (based on a saturated hydraulic conductivity of 1.36×10^{-2} ft/day, an assumed effective porosity of 0.1, and a gradient of 0.039 ft/ft); and toward the northeast at a rate of about 2.72×10^{-3} ft/day (based on a saturate hydraulic conductivity of 1.36×10^{-2} ft/day, an assumed effective porosity of 0.1 and a gradient of 0.020 ft/ft).

Hydraulic conductivity estimates for the alluvial aquifer are based on slug test data (Rockwell, 1989).

2.2.5.4.6 Site Bedrock Hydrogeology

The bedrock aquifer potentiometric surface slopes away from Pad 904, roughly consistent with the dip of the sandstone/siltstone units of the Arapahoe Formation (Figure 22).

Groundwater elevation information for bedrock wells presented in Appendix C suggests that groundwater levels have remained

relatively stable in wells 5-87BR, 9-87BR and 45-87BR (variance within one to three feet), moderately stable in wells 16-87BR and 23-86BR (variance within 15 to 30 feet) and relatively unstable in well 25-86 (variance approximately 60 feet). Based on the contour interval of the bedrock potentiometric map of 20 feet these groundwater elevation variations with time should not significantly effect the general slope of the potentiometric surface presented on Figure 13. Previous alluvial aquifer potentiometric maps for the first through fourth quarters of 1988 (Rockwell, 1989) indicated that bedrock aquifer flow directions and gradients remain fairly constant throughout the year. Therefore, the potentiometric surface presented on Figure 22 is thought to adequately represent bedrock hydrogeologic conditions near Pad 904.

Based on the information presented on the bedrock potentiometric map and cross-sections A-A', B-B' and C-C' the following can be stated about groundwater monitoring in the area of Pad 904 may be made:

- Groundwater flowing south from Pad 904 may be monitored using information collected from wells 9-87BR and 45-87BR,

- Groundwater flowing east from Pad 904 may be monitored using information collected from wells 9-87BR and 16-87BR, and

- Groundwater flowing north from Pad 904 may be monitored using information collected from wells 9-87BR and 22-87BR.

Analysis of bedrock aquifer potentiometric data indicates that groundwater in the bedrock aquifer, which is assumed to occur

predominately in the sandstone/siltstone units in the vicinity of Pad 904, flows toward the south at a rate of 1.92×10^{-3} ft/day under a gradient of 0.170 ft/ft; towards the east a rate of 1.15×10^{-3} ft/day under a gradient of 0.102 ft/ft; and toward the northeast at a rate of 1.38×1^{-3} ft/day under a gradient of 0.122 ft/ft. These ground water flow rates assume an effective porosity of 0.1 and a sandstone saturated hydraulic conductivity of 1.13×10^{-3} ft/day. The hydraulic conductivity values used are based on slug and packer test data (Rockwell, 1989).

GROUNDWATER SAMPLING

Quarterly sampling of monitoring wells at the Plant is initiated immediately upon their completion and development. Water levels are measured monthly as well as at the time of sampling. As was stated above some surficial saturated zone wells are dry upon inspection for quarterly sampling, and as a result no sample is collected.

When water is present and samples are collected, analyses are for the parameters listed in Table 4. During 1986 groundwater samples were analyzed for the Hazardous Substance List (HSL) volatiles, HSL semi-volatiles, and metals as well as major ions and radionuclides.

In 1987 and 1988 analyses were performed by an on-site Rockwell International laboratory. During the first three quarters of 1987, the volatile organic analyte list was reduced to the nine volatile compounds previously detected in groundwater at the Plant. During the fourth quarter of 1987, the Rockwell laboratory obtained a gas chromatograph/mass spectrometer and began analyzing for the full HSL volatile organic compound list. When there is insufficient

water available to analyze the entire suite of parameters samples are collected and analyzed in the following order:

- Volatile Organic Compounds;
- Plutonium, Uranium, and Americium;
- Nitrate;
- Metals;
- Other Major Ions; and
- Other Radionuclides.

Currently, groundwater monitoring is conducted for the parameters listed in Table 4.

TABLE 4
GROUNDWATER SAMPLING PARAMETERS

FIELD PARAMETERS
pH
Specific Conductance
Temperature

INDICATORS
Total Dissolved Solids

METALS
Hazardous Substance List - Metals
- Aluminum
- Antimony
- Arsenic
- Barium
- Beryllium
- Cadmium
- Calcium
- Chromium
- Cobalt
- Copper
- Iron
- Lead
- Magnesium
- Manganese
- Mercury
- Nickel
- Potassium
- Selenium
- Silver
- Sodium
- Thallium
- Vanadium
- Zinc

Cesium
Chromium (hexavalent)
Lithium
Molybdenum
Strontium

ANIONS
Carbonate
Bicarbonate
Chloride
Sulfate
Nitrate
Cyanide

TABLE 4 (con't)
GROUNDWATER SAMPLING PARAMETERS

ORGANICS

Hazardous Substance List - Volatiles:

- Chloromethane
- Bromomethane
- Vinyl Chloride
- Chloroethane
- Methylene Chloride
- Acetone
- Carbon Disulfide
- 1,1-Dichloroethene
- 1,1-Dichloroethane
- trans-1,2-Dichloroethane
- Chloroform
- 1,2-Dichloroethane
- 2-Butanone
- 1,1,1-Trichloroethane
- Carbon Tetrachloride
- Vinyl Acetate
- Bromodichloromethane
- 1,1,2,2-Tetracholoroethane
- 1,2-Dichloropropane
- trans-1,3-Dichloropropene
- Trichloroethene
- Dibromochloromethane
- 1,1,2-Trichloroethane
- Benzene
- cis-1,3-Dichloropropene
- 3-Chloroethyl Vinyl Ether
- Bromoform
- 2-Hexanone
- 4-Methyl-2-pentanone
- Tetrachloroethene
- Toluene
- Ethyl Benzene
- Styrene
- Total Xylenes

Oil and Grease

Hazardous Substance List - Semi-Volatiles:

- 2,4,6-Trichlorophenol
- 2,4,5-Trichlorophenol
- 2-Chloronaphthalene
- 2-Nitroaniline
- Dimethyl Phthalate
- Acenaphthylene
- 2,4-Dinitrophenol

TABLE 4 (con't)
GROUNDWATER SAMPLING PARAMETERS

4-Nitrophenol
Dibenzofuran
2,4-Dinitrotoluene
2,6-Dinitrotoluene
Diethyl Phthalate
4-Chlorophenyl-phenylether
Fluorene
4-Nitroaniline
4,6-Dinitro-2-methylphenol
N-Nitrosodiphenylamine
4-Bromophenyl-phenylether
Hexachlorobenzene
Pentachlorophenol
Phenanthrene
Anthracene
di-n-Butyl Phthalate
Fluoranthene
Pyrene
Butyl Benzyl Phthalate
3,3'-Dichlorobenzidine
Benzo(a)Anthracene
bis(2-ethylhexyl)Phthalate
Chrysene
di-n-Octyl Phthalate
Benzo(b)Fluoranthene
Benzo(k)Fluoranthene
Benzo(a)Pyrene
Indeno(1,2,3-cd)Pyrene
Dibenz(a,h)Anthracene
Benzo(g,h,i)Perylene
bis(2-Chloroethyl)Ether
2-Chlorophenol
1,3-Dichlorobenzene
1,4-Dichlorobenzene
Benzyl Alcohol
1,2-Dichlorobenzene
2-Methylphenol
bis(2-Chloroisopropyl)Ether
4-Methylphenol
N-Nitroso-di-n-propylamine
Hexachloroethane
Nitrobenzene
Isophorone
2-Nitrophenol
2,4-Dimethylphenol

TABLE 4 (con't)
GROUNDWATER SAMPLING PARAMETERS

Benzoic Acid
bis(2-Chloroethoxy)Methane
2,4-Dimethylphenol

1,2,4-Trichlorobenzene
Naphthalene
4-Chloro-3-methylphenol
2-Methylnaphthalene
Hexachlorocyclopentadiene

Hazardous Substance List - Pesticides and PCBS
Alpha-BHC
Beta-BHC
Delta-BHC
Gamma-BHC (Lindane)
Heptachlor
Aldrin
Heptachlor Epoxide
Endosulfan I
Dieldrin
4,4'-DDE
Endrin
Endosulfan II
4,4'-DDD
Endosulfan Sulfate
4,4'-DDT
Methoxychlor
Chlordane
Toxaphene
Arochlor-1016
Arochlor-1221
Arochlor-1232
Arochlor-1242
Arochlor-1248
Arochlor-1254

RADIONUCLIDES
Gross Alpha
Gross Beta
Uranium 233+234, 235, and 238
Americium 241
Plutonium 239+240
Strontium 90
Cesium 137
Tritium

2.2.6 Releases

Spills of Pondcrete and Saltcrete have occurred at Pad 904. The first spill of Pondcrete occurred on May 23, 1988, was followed by spills on July 22, 1988 and September 19, 1988. The first spill of Saltcrete occurred during the period from June 26 through July 16, 1989 and was followed by a second spill which occurred during the period from July 17 through August 25, 1989. The spills did not represent Reportable Quantities (RQ's) as required by the CERCLA spill reporting requirements in that there were no releases to the environment since the spills were onto the asphalt of Pad 904. However, the occurrence of spills have been reported in the RCRA Contingency Plan Implementation Reports or in Monthly Reports on Pondcrete operations submitted to the cognizant regulatory agencies. All spills were cleaned up immediately upon identification. The following section presents highlights of these reports. Appendix D presents RCRA Contingency Plan Implementation Reports and Monthly Pondcrete Operations status reports.

2.2.6.1 Releases to the Pad

Pondcrete

May 23, 1988 Spill

The incident was discovered at approximately 5:10 a.m. on Monday, May 23, 1988 by a foreman at the Plant, who noticed deformed boxes of Pondcrete on Pad 904. The operators of the Pad were dispatched by the foreman and confirmed the presence of deformed boxes of Pondcrete at approximately 9:00 a.m. The foreman immediately notified the Plant Shift Superintendent (RCRA Emergency Director), the Plant Radiation Monitoring group and the Plant Fire Department.

Activities related to unstacking the Pondcrete boxes began immediately in an effort to prevent any of the stacked boxes from toppling over and causing a spill (the boxes of waste are stacked three high). While unstacking the boxes with a forklift one box fell off the forklift onto the asphalt of Pad 904. The plastic liner of the triple walled Pondcrete box failed on impact and approximately 0.25 cubic feet (ft3) of Pondcrete was spilled onto the asphalt Pad. This 0.25 ft3 release of Pondcrete distributed itself across approximately a two square foot (ft2) area of the Pad. No other incidents occurred that day during the unstacking procedure.

Following the incident the entire contents of the failed container and the spilled Pondcrete were transferred into a four by four by seven foot DOT Type 7A metal box with hand tools. This container was transferred to an indoor area (Building 788 [RCRA Unit Number 48]) for temporary holding while awaiting reprocessing. The location of the Pad where the Pondcrete had spilled was then cleaned by washing with water using brooms to remove Pondcrete from crevices in the asphalt. Approximately five gallons of wash water was then collected using a wet vacuum cleaner. This cleaning effort was continued until radiation levels were below the detection limit of the instruments being used. This liquid was then transferred to the Pondcrete processing area for reprocessing into Pondcrete.

Within a few hours following this spill, two portable ambient air monitors were moved to the Pad. One sampler was located in the center of the Pad and the second sampler was located on the eastern edge of the Pad, in the predominant downwind direction.

Analytical results indicated that concentrations of plutonium in air associated with that spill were below the Plant Safety Guide level of 0.01 pCi/m3.

July 22, 1988 Spill

The incident occurred at approximately 9:00 a.m. on Friday, July 22, 1988. The Plant Shift Superintendent (RCRA Emergency Director) immediately notified the Plant Radiation Monitoring group and the Plant Fire Department.

The spill resulted from activities related to unstacking the Pondcrete boxes. The boxes were being unstacked in an effort to prevent additional damage to a deformed box of Pondcrete. The first step in unstacking an array of Pondcrete boxes was the removal of the tarpaulin covering the array. During the process of tarpaulin removal one of the top boxes of the array slid off the array. The plastic liner of the triple walled Pondcrete box failed on impact and approximately 12 ft3 of Pondcrete was spilled onto the asphalt Pad. This 12 ft3 release of Pondcrete distributed itself across an area of approximately 36 ft2 of the Pad. The remainder of the unstacking procedure that day proceeded without incident.

The spill was cleaned by transferring the entire contents of the failed container and the spilled Pondcrete into a four foot by four foot by seven foot DOT Type 7A metal box with hand tools and transferring this container to an indoor area (Building 788 [RCRA Unit Number 48]) for temporary holding while awaiting reprocessing. The location of the Pad where the Pondcrete had spilled was then cleaned by washing with water using brooms to remove Pondcrete from crevices in the asphalt. This cleaning effort was continued until

radiation levels were below the 250 counts per minute, detection limit of the Ludlum Model 12 meter being used. Approximately 15 gallons of wash water was then collected using a wet vacuum cleaner. This liquid was then transferred to the Pondcrete processing area for reprocessing into Pondcrete.

Water samples from the water collected in the wet vacuum cleaner were found to contain gross Alpha and Beta at concentrations of 32 +/- 26 and 47 +/- 49 pCi/l, respectively. Samples of the concentrated Pondcrete liquids were collected near the northern berm. These samples were found to contain gross Alpha and Beta at concentrations of 1,300 +/- 300 and 2,200 +/- 300 pCi/l, respectively. In addition, one sample of sediment contaminated by liquid associated with the Pondcrete was also collected. Gross Alpha and Beta concentrations related to the evaporite sample were 18,000 +/- 1000 and 2,800 +/- 200 pCi/gm, respectively.

September 19, 1988

A leaking box of Pondcrete was identified during a routine inspection on September 19, 1988. The suspect box and two other boxes of Pondcrete were transferred to a metal crate to await reprocessing.

Saltcrete

June 26, Through July 16, 1989

Two boxes of leaking Saltcrete were found to have leaked a total of 11 pounds of dry material to Pad 904.

July 17 Through August 20, 1989

One box of leaking Saltcrete was found to have leaked a total of approximately two pounds of dry material to Pad 904.

Following identification of the Saltcrete storage problems, the entire contents of the failed container and the spilled Saltcrete were transferred into a four foot by four foot by seven foot metal container. The metal containers have been stored on Pad 904 awaiting reprocessing. The location of the Pad where the Saltcrete had spilled was cleaned by vacuuming until radiation levels were below the detection limit of the instruments being used. The collected material was transferred to Building 374 for reprocessing or stored on Pad 904 in a four foot by four foot by seven foot metal container awaiting reprocessing.

2.2.6.2 Releases to the Air

Releases to air from waste storage activities at Pad 904 are unlikely since the wastes are nonvolatile by nature. The most likely time a release to air would occur would be during a spill incident such a release would most likely consist of fine grained particles. As was stated in Section 2.2.5.1 there have been no releases that exceeded the Plant Screening Guide for plutonium in air of 0.01 pCi/m3.

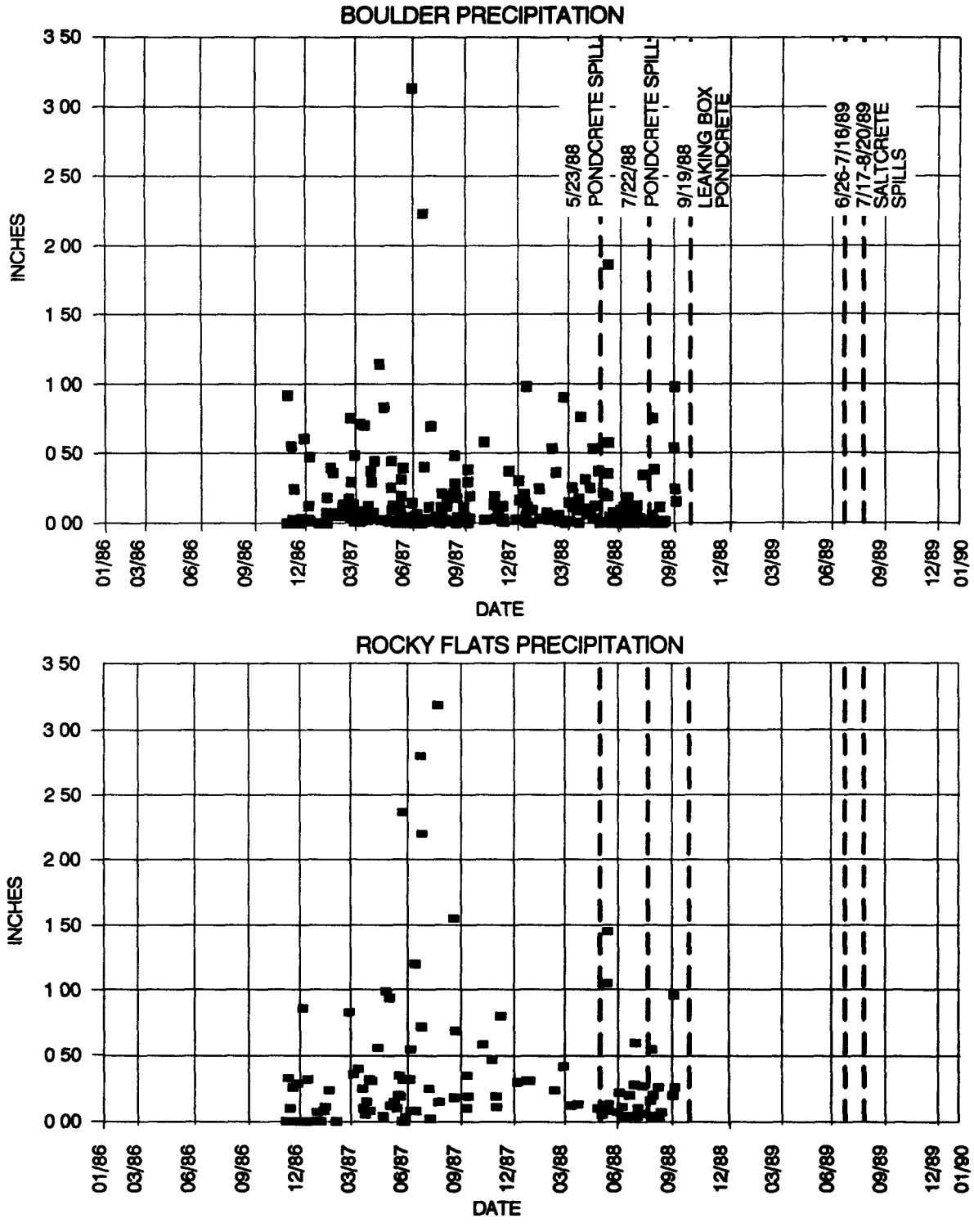
2.2.6.3 Releases to Surface Water

During the period from August 1987 to June 6, 1988 Pad 904 existed without the runoff containment berms described in Sections 2.1 and 2.2.5.2. As a result of this configuration of the Pad all runoff would exit the Pad without retention. Based on the slope of the

Pad these waters would be expected to exit the Pad to the north and east. Once the water had exited the Pad it would be intercepted by a ditch running along the east side of the Pad and this water would then be intercepted by a ditch running along the north side of the Pad (Figure 23). Once in the northern ditch the water is collected in a culvert and routed under Central Avenue. As the water exits the culvert it is routed east through a ditch running north of Central Avenue. Water in this ditch is then collected by a culvert and diverted to Pond B-4 (Figure 16) for retention prior to release.

On June 6, 1988 berms were constructed along the north, west and east sides of the Pad to contain a portion of the surface runoff from the Pad (Figures 3 and 4). However, as was stated in Section 2.2.5.2 the berms are capable of containing the runoff related to a precipitation event of approximately one-inch.

Records of daily precipitation at Rocky Flats for the period January 1, 1987 through September 15, 1988 are presented on Figure 24. These data were collected at Building 774 during 24-hour periods ending at 7:00 a.m. Comparison of the Rocky Flats daily data with those from the National Weather Services observation at Boulder (Figure 24), indicate that there may be some missing days in the Rocky Flats data, but overall the Rocky Flats record is judged to be good. Analysis of this information indicates that since the berms have been in place (June 6, 1988) through the period of record at Rocky Flats (September 15, 1988) there were no rainfall events greater than one inch. However, successive days of less than one inch precipitation events may also cause overtopping of the berm. Reports of berm overtopping by Plant



PRECIPITATION
BOULDER AND ROCKY FLATS

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

PROJECT NO 667-10

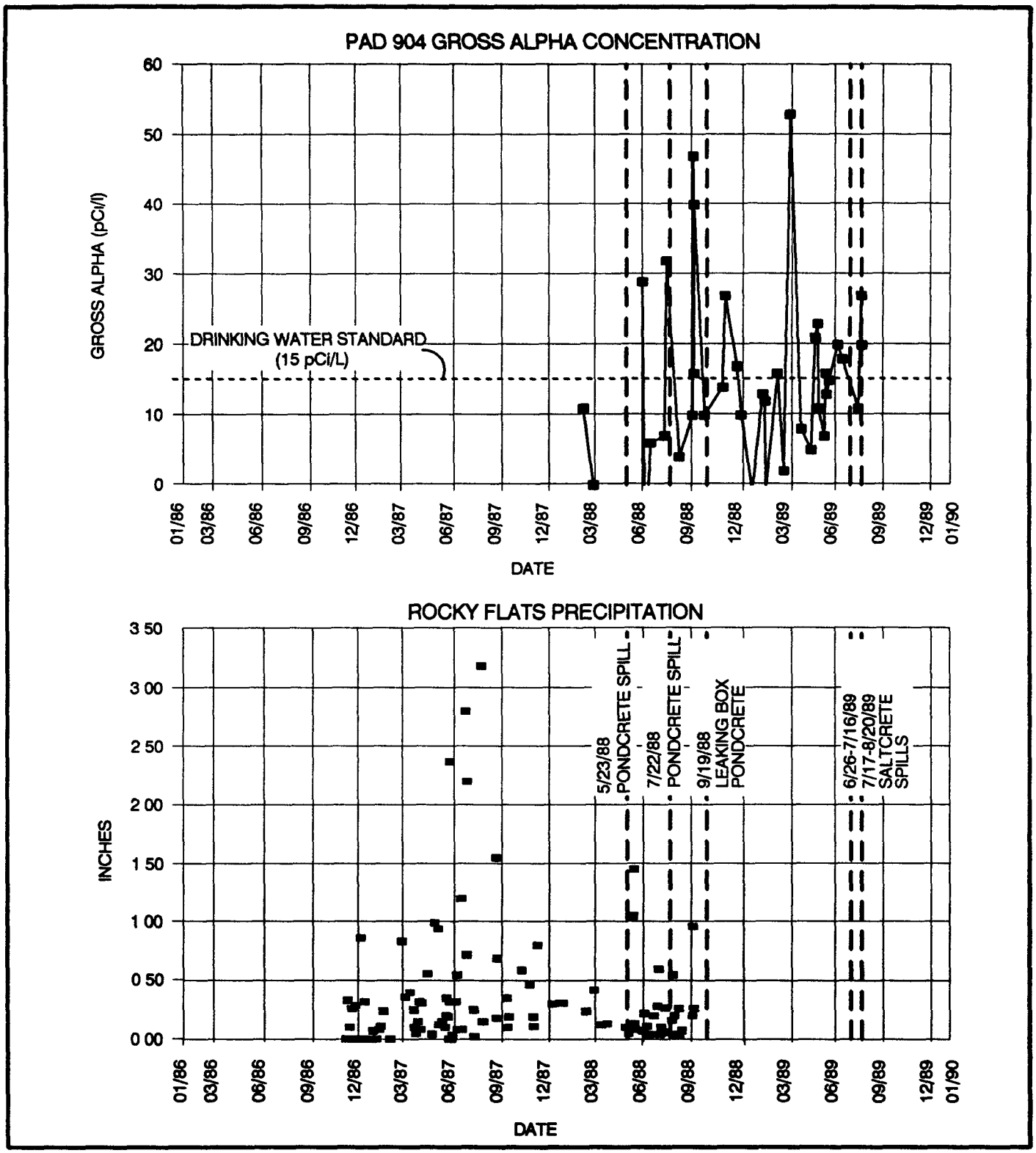
FIGURE NO. 24

personnel suggest that the occurrence of these successive lower intensity precipitation events have indeed resulted in berm overtopping.

Collection of runoff water samples from ponded areas within the bermed area has been done in an effort to assess contaminant concentrations in runoff. Interpretation of the analytical results of these grab samples is difficult because of uncertainties in the relationship between the precipitation event and sample collection. These uncertainties may lead to sample concentration values being lower or higher than those related to the actual runoff water. Runoff concentrations could be underestimated by subsequent precipitation diluting the ponded water. Over estimation of runoff concentrations could occur due to a runoff volume insufficient to overtop the berm followed by a time lag before sample collection allowing evaporation of a portion of the ponded water. On the basis of the information presented above the interpretations given below are generalizations based upon uncertainty as to peak concentrations and average storm-related concentrations.

Gross alpha, gross beta and nitrate-nitrogen concentrations for grab samples of Pad 904 runoff for the period from February 12, 1988 through June 6, 1989 are presented on Figures 25, 26 and 27, respectively. The Pondcrete spills of May 23 and July 22, 1988 as well as the Pondcrete leakage of September 19, 1988 are highlighted on these figures.

No surface water was known to discharge to the environment as a result of these two spills and the one leak. All water used in Pad decontamination was contained on the Pad until removed by pumping. However, leakage of precipitation runoff under the berm has been

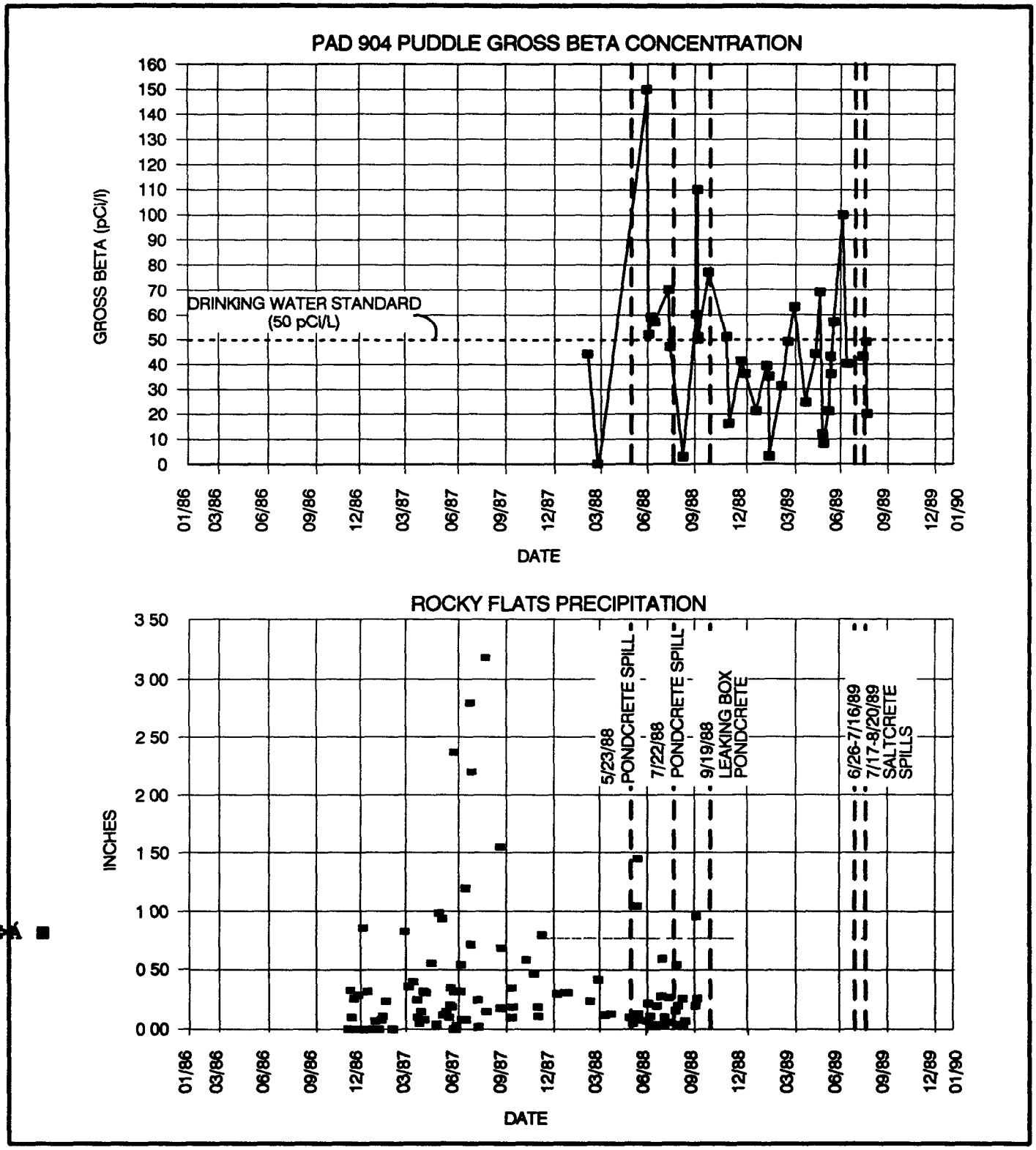


GROSS ALPHA CONCENTRATIONS
IN PAD 904 PUDDLES

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

PROJECT NO. 667 10

FIGURE NO. 25

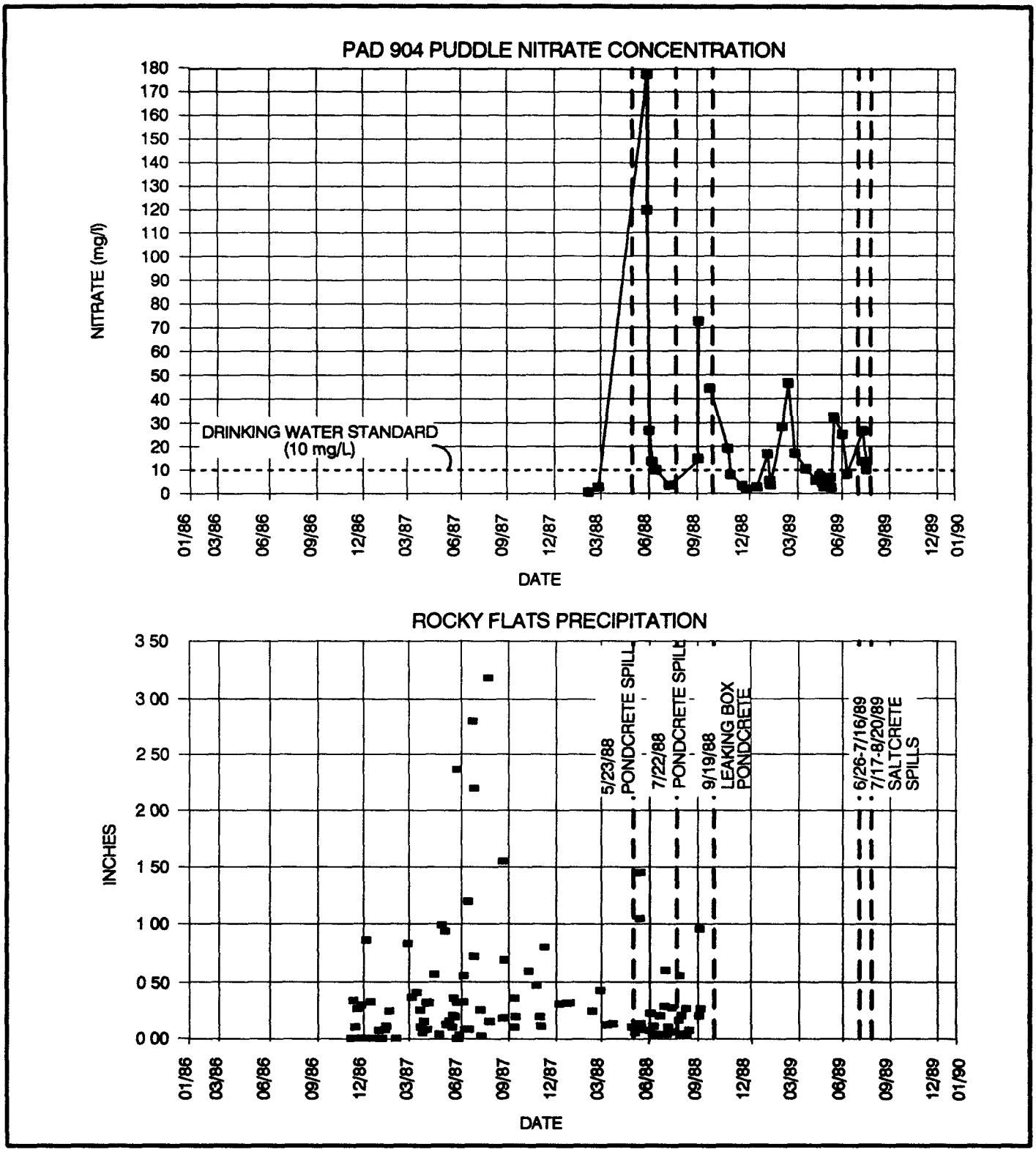


GROSS BETA CONCENTRATIONS
IN PAD 904 PUDDLES

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

PROJECT NO 667-10

FIGURE NO. 26



NITRATE CONCENTRATIONS
IN PAD 904 PUDDLES

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

PROJECT NO 667-10

FIGURE NO 27

routinely observed by Rocky Flats personnel. Therefore, it is expected that some leakage may occur at approximately the concentrations presented on Figures 25 through 27.

Impact on isotope concentrations of the Pad runoff due to the July 22, 1988 Pondcrete spill is presented in Table 5. These data indicate that concentrations of plutonium, americium and uranium were generally an order of magnitude or more greater than pre-July 22 spill runoff concentrations.

Data for Pad 904 runoff sample concentrations of gross Alpha, gross beta and nitrates appear to be log-normally distributed (Figures 28, 29 and 30). The correlation coefficients for the lines drawn through these data vary from 0.99 to 1.0, strongly indicating the log-normal nature of the data and the excellent fit of the lines to the data.

Using these lines (Figures 28, 29 and 30) to describe the runoff data, 59 percent of all runoff samples were less than or equal to the gross alpha drinking water standard of 15 pCi/l, 63 percent of all runoff samples were less than or equal to the gross beta drinking water standard of 50 pCi/l and 52 percent of all runoff samples were less than or equal to the drinking water standard of 10 mg/l of nitrate-nitrogen,. This analysis indicates that the water released from the Pad was typically of good quality (did not exceed drinking water standards). Data reports for Pad 904 runoff data are found in Appendix E.

The analyses of the data presented above indicate that runoff from Pad 904 may be contributing to some elevated analyte concentrations in the South Walnut Creek water. It is believed that Pad 904

TABLE 5

ISOTOPE SPECIFIC ANALYSES BEFORE SPILL (JUNE 26, 1988) AND AFTER SPILL (JULY 22, 1988)

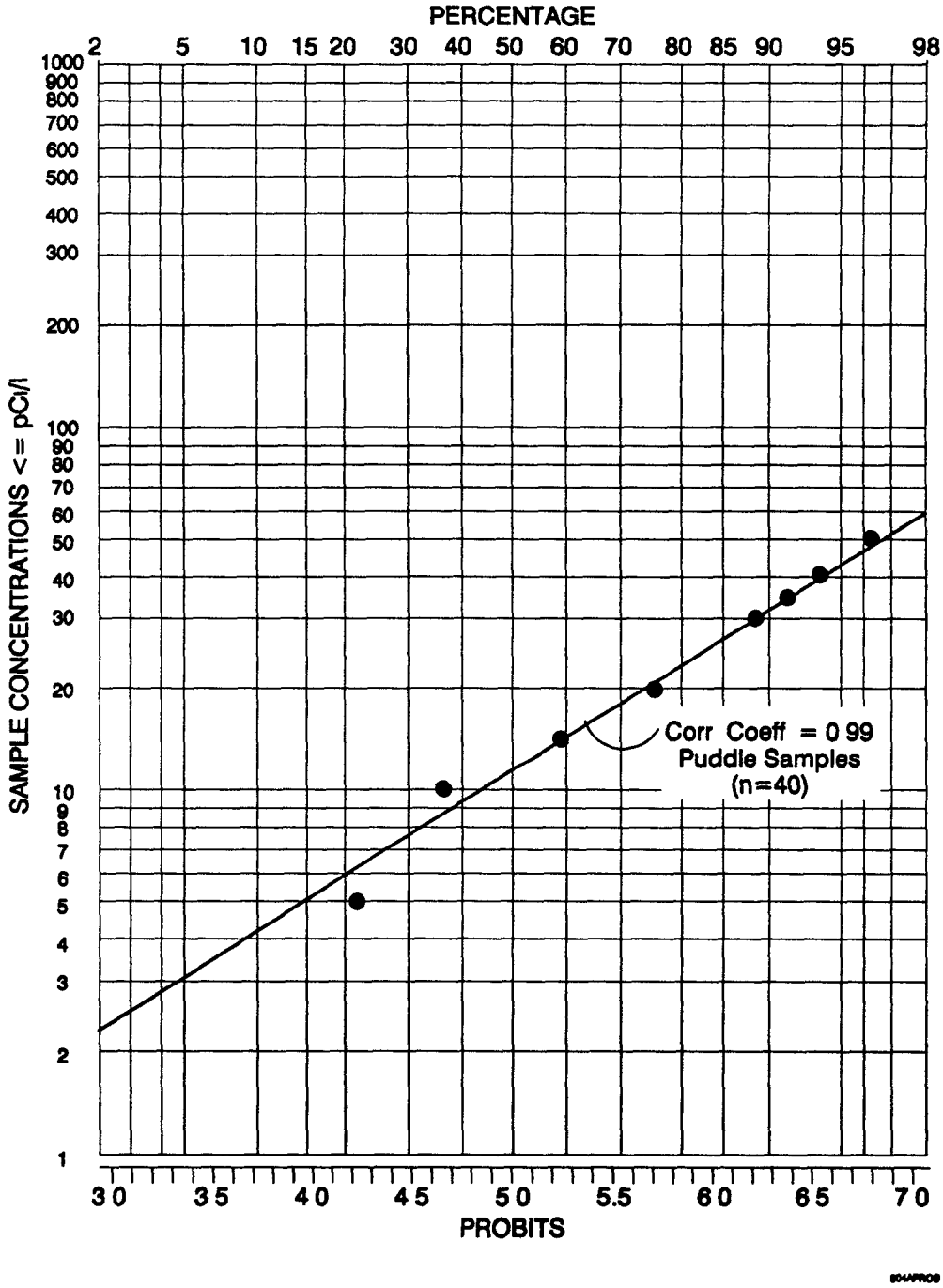
Isotope	June 26, 1988	July 22, 1988
Pu-238	0.017 ± 0.021	--[3]
Pu-239	0.506 ± 0.088	620 ± 80
Am-241	0.834 ± 0.127	3200 ± 300
U-234	1.414 ± 0.231	140 ± 30
U-235	--	35 ± 17
U-238	1.312 ± 0.186	110 ± 30
Gross Alpha [1]	--	18000 ± 1000 [2]
Gross Beta [1]	--	2800 ± 200 [2]

Concentration (pCi/l, unless otherwise specified)

1) For sediment sample collected at northeast corner of 904 pad after 7/22/88 spill

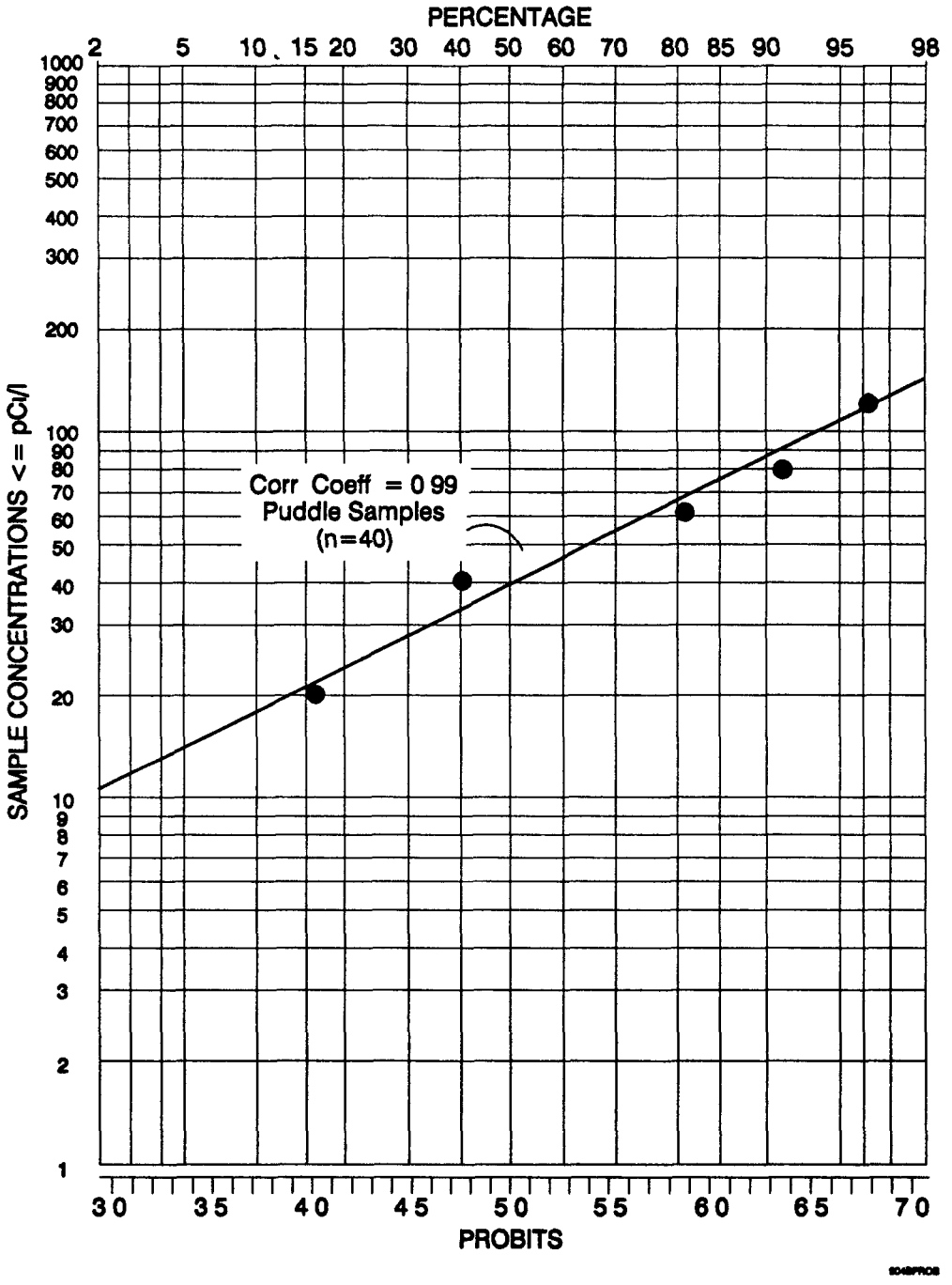
2) pCi/gm

3) -- means no analyses for sample



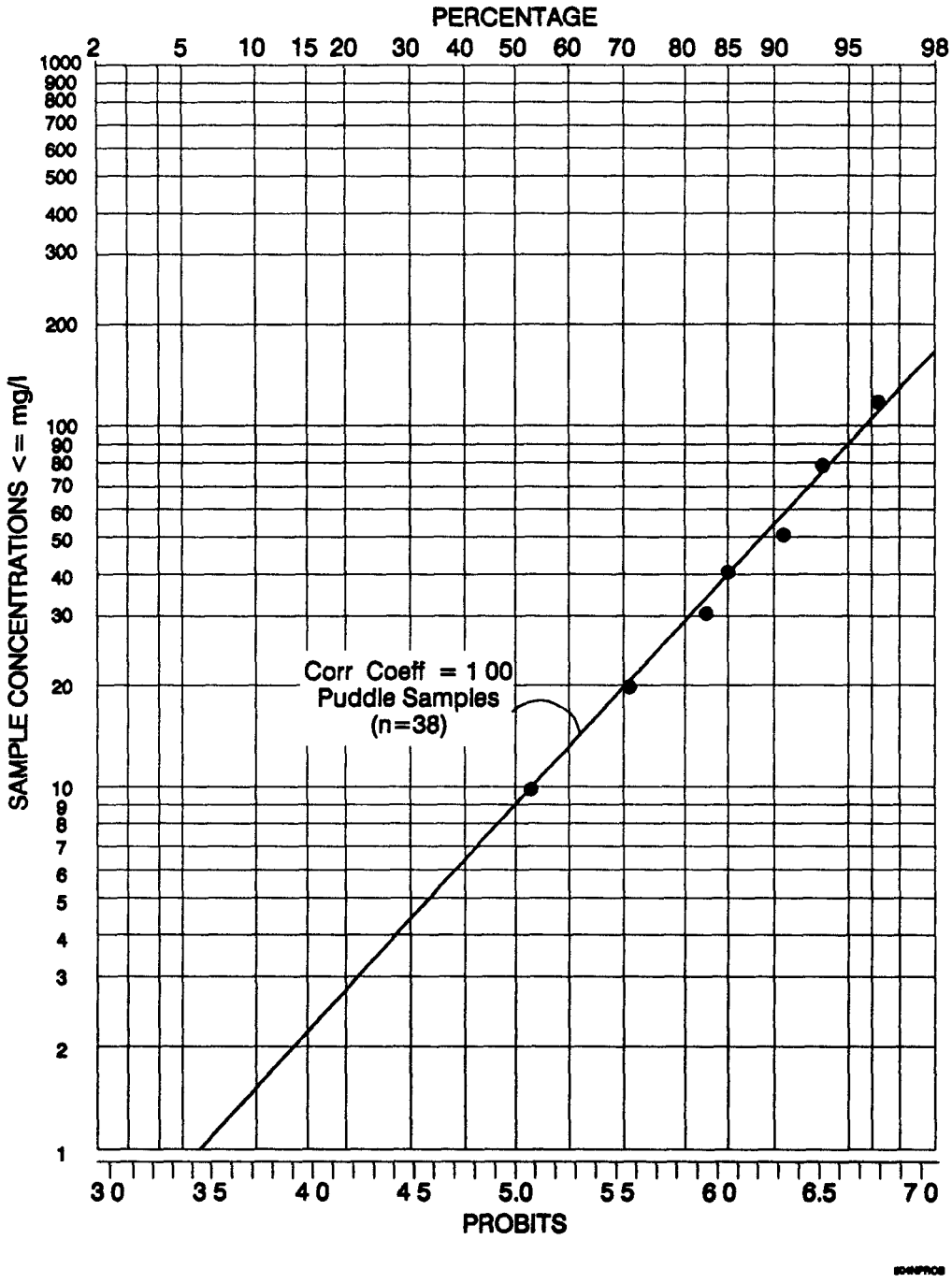
PROBABILITY OF RUNOFF GROSS ALPHA CONCENTRATIONS

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO
FIGURE 28



PROBABILITY OF RUNOFF GROSS BETA CONCENTRATIONS

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO
FIGURE 29



PROBABILITY OF RUNOFF NITRATE CONCENTRATIONS

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO
FIGURE 30

represents just one of many sources of contamination to the South Walnut Creek Drainage.

South Walnut Creek is diverted near Building 991 into Pond B-4, thereby bypassing ponds B-1 through B-3 (Figure 17). Ponds B-1 and B-2 are spill control ponds that normally do not discharge down the South Walnut Creek drainage. Pond B-3 is a holding pond for the treated effluent from the Rocky Flats Sanitary Wastewater Treatment Plant (Building 995). The water from Pond B-3 is spray evaporated near Pond B-3, unless the pipes are frozen. Pond B-4, which contains both treated sanitary effluent and incoming South Walnut Creek flow, intermittently discharges to Pond B-5 which is the last control point on the South Walnut Creek drainage. All discharges from Pond B-5 must meet the National Pollutant Discharge Elimination System (NPDES) Permit for the Rocky Flats Plant. Pond B-5 is designated NPDES discharge location 006. The NPDES permit is currently being renegotiated, with completion expected in December 1989.

2.2.6.4 Releases to Soil

All spills which have occurred to date at Pad 904 have remained on the paved area and were immediately cleaned up, and therefore do not constitute releases to soil. However, contaminated runoff that leaves the Pad contacts soil in the adjacent ditches and flows through culverts to its final discharge to the South Walnut Creek drainage. Due to the relatively low concentrations of contaminants in Pad 904 runoff water (contaminant concentrations typically meet drinking water standards) concentrations of contaminants in soils adjacent to the Pad and in the South Walnut Creek drainage are expected to be very low.

Specifically, soil near the Pad was sampled following the May 23, 1988 spill incident and data related to this sampling is presented in Table 3 and on Figures 10, 11 and 12.

2.2.6.5 Releases to Groundwater

Groundwater should not be impacted by the Pad operations since, based on runoff data, contaminants released from the Pad in runoff are present in relatively low concentrations (typically meeting drinking water standards). No other releases to soil have occurred. Further, Pad 904 retains at least some of the precipitation which could conceivably leach contaminants from the previously contaminated soil which underlie the Pad.

An analysis of the concentrations of what are considered to be indicator parameters, based on the waste types found in Pondcrete, indicate that several indicator parameters were found at concentrations equal to or above performance criteria in groundwater near the Pad (Table 6). The following paragraphs discuss relevant parameters and the concentrations found.

The performance criterion for nitrate of 10 mg/l was met or exceeded only in groundwater samples collected from alluvial well 26-86 prior to the construction of Pad 904. Further, this alluvial well appears to be hydraulically disconnected from the Pad and appears to be hydraulically connected to the solar ponds.

The performance criterion for acetone of 0.005 mg/l was met or exceeded in groundwater samples collected from alluvial well 15-87 and bedrock wells 25-86BR, 5-87BR and 45-87BR. All occurrences of elevated concentrations were at approximately the time of construction of the Pad and approximately six to 12 months prior to the first Pondcrete spill at the Pad.

Table 6
Groundwater Concentrations in the Area of Pad 904

WELL #	DATE	NITRATE (mg/l)	ACETONE (mg/l)	BEHT (mg/l)	PU 239,240 (pCi/l)		RANGE (pCi/l)	MDA (pCi/l)	AM 241 (pCi/l)		RANGE (pCi/l)	MDA (pCi/l)	TRITIUM (pCi/l)		RANGE (pCi/l)	MDA (pCi/l)
Performance Std.		10	0 005	0.005	15				30				20000			
ALLUVIAL WELLS																
24-86	09/01/86	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
24-86	09/24/87	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
24-86	12/05/87	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
24-86	03/16/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
24-86	05/23/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
24-86	09/08/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
24-86	11/22/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
26-86	09/18/86	300.00	-0.005 •	IS	IS	+/-			IS	+/-			IS	+/-		
26-86	03/18/87	88.00	NR	IS	IS	+/-			IS	+/-			IS	+/-		
26-86	08/28/87	79.00	NR	IS	0 07	+/-	0 58	0.30	-0.04	+/-	0 60	1 10	1352 00	+/-	343.00	
26-86	12/05/87	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
26-86	03/16/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
26-86	05/17/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
26-86	09/06/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
26-86	11/22/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
33-86	09/12/86	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
33-86	09/24/87	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
33-86	12/05/87	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
33-86	03/07/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
33-86	05/02/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
33-86	08/12/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
33-86	11/08/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
61-86	03/10/87	1.10	NR	IS	IS	+/-			IS	+/-			IS	+/-		
61-86	05/04/87	1.70	NR	IS	IS	+/-			IS	+/-			IS	+/-		
61-86	06/23/87	1.98	NR	IS	IS	+/-			IS	+/-			IS	+/-		
61-86	08/27/87	0.78	NR	IS	0 30	+/-	1.30	1 80	0.00	+/-	0 60	0 50	<509	+/-		
61-86	10/12/87	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		
61-86	02/12/88	0.88	.010 U	IS	0 00	+/-	0.13		0.00	+/-	0.16		<220	+/-		
61-86	04/18/88	1.19	.010 U	IS	0.00	+/-	0 05	0 26	0.00	+/-	0 16	0.80	<210	+/-		
61-86	07/18/88	IS	.010 U	IS	IS	+/-			IS	+/-			IS	+/-		
61-86	10/17/88	DRY	DRY	DRY	DRY	+/-			DRY	+/-			DRY	+/-		

Table 6
Groundwater Concentrations in the Area of Pad 904 (con't)

WELL #	DATE	NITRATE (mg/l)	ACETONE (mg/l)	BEHT (mg/l)	PU 239,240 (pCi/l)	RANGE (pCi/l)	MDA (pCi/l)	AM 241 (pCi/l)	RANGE (pCi/l)	MDA (pCi/l)	TRITIUM (pCi/l)	RANGE (pCi/l)	MDA (pCi/l)
Performance Std.		10	0.005	0.005	15			30			20000		
ALLUVIAL WELLS													
04-87	05/20/87	5.80	NR	IS	IS +/-			IS +/-			IS +/-		
04-87	05/26/87	IS	.004 J	IS	IS +/-			IS +/-			IS +/-		
04-87	07/09/87	6.00	NR	IS	0.14 +/-	0 73	0.70	0.70 +/-	0.86	1.00	777 00 +/-	333 00	
04-87	10/14/87	3.76	NR	IS	0.06 +/-	0.14		0 20 +/-	0.07		<460 +/-		
04-87	10/14/87	IS	IS	0.002 *	IS +/-			IS +/-			IS +/-		
04-87	02/15/88	2.60	.010 U	IS	0.00 +/-	0.24		0.00 +/-	0.14		<210 +/-		
04-87	04/13/88	3.86	.010 U	IS	0.00 +/-	0.05	0.17	0 00 +/-	0.16	0.60	<220 +/-		220 00
04-87	07/14/88	4.99	.010 U	IS	DNYR +/-			DNYR +/-			DNYR +/-		
04-87	10/20/88	9.53	.010 U	IS	DNYR +/-			DNYR +/-			DNYR +/-		
10-87	10/12/87	DRY	DRY	DRY	DRY +/-			DRY +/-			DRY +/-		
10-87	02/25/88	DRY	DRY	DRY	DRY +/-			DRY +/-			DRY +/-		
10-87	04/19/88	DRY	DRY	DRY	DRY +/-			DRY +/-			DRY +/-		
10-87	08/09/88	DRY	DRY	DRY	DRY +/-			DRY +/-			DRY +/-		
10-87	10/26/88	DRY	DRY	DRY	DRY +/-			DRY +/-			DRY +/-		
15-87	09/10/87	7.60	NR	IS	NR +/-			NR +/-			<460 +/-		
15-87	09/11/87	IS	IS	IS	0 52 +/-	0 12		0 83 +/-	0.15		NR +/-		
15-87	10/07/87	IS	1.280 *	IS	IS +/-			IS +/-			IS +/-		
15-87	10/08/87	IS	IS	IS	IS +/-			IS +/-			IS +/-		
15-87	10/08/87	9.10	IS	IS	0.00 +/-	0.16		0.00 +/-	0.25		<500 +/-		
15-87	10/08/87	IS	IS	IS	0.04 +/-	0 06		0.04 +/-	0.05		NR +/-		
15-87	02/29/88	3.88	.010 U	IS	0.00 +/-	0.19		0.00 +/-	0.10		<210 +/-		
15-87	04/20/88	4.82	.010 U	IS	0.00 +/-	0.05	0 13	0 00 +/-	0 16	0.75	<210 +/-		
15-87	08/09/88	DRY	DRY	DRY	DRY +/-			DRY +/-			DRY +/-		
15-87	10/31/88	DRY	DRY	DRY	DRY +/-			DRY +/-			DRY +/-		
44-87	11/14/87	DRY	DRY	DRY	DRY +/-			DRY +/-			DRY +/-		
44-87	02/22/88	DRY	DRY	DRY	DRY +/-			DRY +/-			DRY +/-		
44-87	04/18/88	DRY	DRY	DRY	DRY +/-			DRY +/-			DRY +/-		
44-87	07/20/88	DRY	DRY	DRY	DRY +/-			DRY +/-			DRY +/-		
44-87	10/26/88	DRY	DRY	DRY	DRY +/-			DRY +/-			DRY +/-		

Table 6
Groundwater Concentrations in the Area of Pad 904 (con't)

WELL #	DATE	NITRATE (mg/l)	ACETONE (mg/l)	BEHT (mg/l)	PU 239,240 (pCi/l)	+/-	RANGE (pCi/l)	MDA (pCi/l)	AM 241 (pCi/l)	+/-	RANGE (pCi/l)	MDA (pCi/l)	TRITIUM (pCi/l)	+/-	RANGE (pCi/l)	MDA (pCi/l)
Performance Std.		10	0.005	0.005	15				30				20000			
BEDROCK WELLS																
23-868R	11/25/86	IS	.010 U	IS	IS	+/-			IS	+/-			IS	+/-		
23-868R	03/18/87	NR	NR	IS	IS	+/-			IS	+/-			IS	+/-		
23-868R	06/24/87	IS	NR	IS	IS	+/-			IS	+/-			IS	+/-		
23-868R	09/23/87	IS	NR	IS	IS	+/-			IS	+/-			IS	+/-		
23-868R	01/15/88	.02 U	.010 U	IS	0 00	+/-	0 16	0 91	0 01	+/-	0.11	0.61	<220	+/-		
23-868R	03/21/88	.07 U	.010 U	IS	0 00	+/-	0 71		0 05	+/-	0.10		<210	+/-		
23-868R	05/23/88	.02 U	.010 U	IS	0 00	+/-	0.04	0 13	0 04	+/-	0.11	0.67	<200	+/-		
23-868R	09/08/88	IS	.010 U	IS	IS	+/-			IS	+/-			IS	+/-		
23-868R	11/30/88	IS	.010 U	IS	IS	+/-			IS	+/-			IS	+/-		
25-868R	11/07/86	IS	0.017 *	IS	IS	+/-			IS	+/-			IS	+/-		
25-868R	03/18/87	0.28	NR	IS	IS	+/-			IS	+/-			IS	+/-		
25-868R	06/24/87	.20 U	NR	IS	IS	+/-			IS	+/-			IS	+/-		
25-868R	08/28/87	0.45	NR	IS	0 29	+/-	0.77	0.70	-0.04	+/-	0.18	0 40	<492	+/-		
25-868R	01/15/88	0.10	.010 U	IS	0 00	+/-	0 49	5 90	NR	+/-			<220	+/-		
25-868R	01/15/88	0.10	.010 U	IS	0 00	+/-	0.24	1.20	0.00	+/-	0.10	0 53	<220	+/-		
25-868R	03/21/88	0.12	.010 U	IS	NR	+/-			0 03	+/-	0 30		<210	+/-		
25-868R	05/18/88	0.07	.010 U	IS	0 02	+/-	0 05	0.15	NR	+/-			<200	+/-		
25-868R	09/13/88	0.13	.010 U	IS	NR	+/-			NR	+/-			<200	+/-		
25-868R	09/13/88	.02 U	.010 U	IS	NR	+/-			NR	+/-			<200	+/-		
25-868R	12/06/88	0.11	.010 U	IS	NR	+/-			NR	+/-			<220	+/-		
05-878R	06/11/87	IS	0 006 *	IS	IS	+/-			IS	+/-			IS	+/-		
05-878R	06/12/87	9.50	NR	IS	IS	+/-			IS	+/-			IS	+/-		
05-878R	07/06/87	8.60	NR	IS	0.60	+/-	1 40	1 90	-0 04	+/-	1.41	2 40	<493	+/-		
05-878R	10/12/87	9.62	NR	IS	0.06	+/-	0 12		0.00	+/-	0.12		<460	+/-		
05-878R	10/12/87	IS	.030 U	IS	IS	+/-			IS	+/-			IS	+/-		
05-878R	02/22/88	8.70	.010 U	IS	0 00	+/-	0 27		NR	+/-			<220	+/-		
05-878R	04/11/88	1.90	.004 J	IS	0.02	+/-	0 06	0.19	NR	+/-			<220	+/-		220 00
05-878R	07/19/88	9.48	.010 U	IS	DNYR	+/-			DNYR	+/-			DNYR	+/-		
05-878R	10/20/88	0.02 U	IS	IS	DNYR	+/-			DNYR	+/-			DNYR	+/-		
05-878R	11/14/88	IS	.010 U	IS	IS	+/-			IS	+/-			IS	+/-		

Table 6
Groundwater Concentrations in the Area of Pad 904 (con't)

WELL #	DATE	NITRATE (mg/l)	ACETONE (mg/l)	BEHT (mg/l)	PU 239,240 (pCi/l)	RANGE (pCi/l)	MDA (pCi/l)	AM 241 (pCi/l)	RANGE (pCi/l)	MDA (pCi/l)	TRITIUM (pCi/l)	RANGE (pCi/l)	MDA (pCi/l)
Performance Std.		10	0.005	0.005	15			30			20000		
BEDROCK WELLS													
09-87BR	06/19/87	IS	0.003 *	IS	IS +/-			IS +/-			IS +/-		
09-87BR	10/12/87	2.96	NR	IS	0.08 +/-	0.10		0 00 +/-	0 06		510.00 +/-	290 00	
09-87BR	10/12/87	IS	.010 U	IS	IS +/-			IS +/-			IS +/-		
09-87BR	02/25/88	1.85	.010 U	IS	0.00 +/-	0 35		NR +/-			350.00 +/-	80 00	
09-87BR	04/19/88	2.81	.010 U	IS	0.00 +/-	0 05	0.17	0 04 +/-	0.24	1.20	250 00 +/-	90 00	
09-87BR	08/09/88	2.57	.010 U	IS	NR +/-			NR +/-			370.00 +/-	100 00	
09-87BR	10/26/88	2.02	010 U	IS	DNYR +/-			DNYR +/-			DNYR +/-		
16-87BR	09/10/87	0.46	NR	IS	NR +/-			NR +/-			<500 +/-		
16-87BR	09/15/87	IS	IS	IS	NR +/-			NR +/-			<500 +/-		
16-87BR	10/16/87	1.58	NR	IS	0 05 +/-			0 01 +/-	0 07		<460 +/-		
16-87BR	10/16/87	IS	.010 U	IS	IS +/-			IS +/-			IS +/-		
16-87BR	02/29/88	0.35	.010 U	IS	0 00 +/-			0.03 +/-	0 12		<220 +/-		
16-87BR	04/21/88	0.05	.010 U	IS	0 02 +/-			0 02 +/-	0.16	0.51	<210 +/-		
16-87BR	08/09/88	0.02 U	010 U	IS	0 00 +/-			0 02 +/-	0 09	0 36	<210 +/-		
16-87BR	10/31/88	1.46	.010 U	IS	DNYR +/-			DNYR +/-			DNYR +/-		
45-87BR	11/23/87	0.02 U	.010 U	IS	0 00 +/-	0 12	0.56	0.00 +/-	1 40	6.90	<220 +/-		
45-87BR	11/23/87	IS	0.170 *	IS	IS +/-			IS +/-			IS +/-		
45-87BR	02/25/88	0.02 U	.010 U	IS	0 00 +/-	0.18		NR +/-			<200 +/-		
45-87BR	04/18/88	0.05	.005 J	IS	0 00 +/-	0 03	0.15	0 10 +/-	0 16	0.81	<200 +/-		
45-87BR	07/21/88	0.07	.010 U	IS	DNYR +/-			DNYR +/-			DNYR +/-		
45-87BR	10/17/88	0.06	.010 U	IS	DNYR +/-			DNYR +/-			DNYR +/-		

KEY:
B= PRESENT IN LAB BLANK
BEHT= bis(2-ETHYLHEXYL)PHTHALATE
DNYR= DATA NOT YET RECEIVED
DRY= DRY WELL; NO SAMPLE
IS= INSUFFICIENT SAMPLE
J= PRESENT BELOW DETECTION LIMIT
MDA= MINIMUM DETECTABLE ACTIVITY
NR= ANALYTE NOT REPORTED
U= ANALYZED BUT NOT DETECTED
*= ADJUSTED VALUE BASED ON CONCENTRATION IN LAB BLANK

The performance criterion for bis(2-ethylhexyl)phthalate (BEHT) of 0.005 mg/l was never found to be met or exceeded in water collected from alluvial or bedrock wells.

The performance criteria for Plutonium-239,-240 and americium-241 of 15 and 30 pCi/l, respectively, were not found to be met or exceeded in any of the groundwater samples collected from either the alluvial or bedrock aquifer systems near Pad 904.

3.0 CLOSURE PLAN SUMMARY

3.1 Closure Objectives

This interim status closure plan has been prepared to meet the performance standards of 6 CCR 1007-3, Section 265.111. The promulgated standards require a facility be closed in a manner that:

- Minimizes the need for further maintenance; and
- Controls, minimizes or eliminates, to the extent necessary to protect human health and the environment, post-closure escape of hazardous waste, hazardous waste constituents, leachate, contaminated rainfall, or waste decomposition products to the ground or surface waters or to the atmosphere.

3.2 Closure Activities

The progression of activities necessary to complete closure is shown in Figure 3. Principal activities include:

- Removal of all wastes currently stored on Pad 904 Area A,
- Decontamination of Pad surfaces (if required),
- Verification of Pad decontamination (if required),
- Verification of acceptable levels of soil contamination,

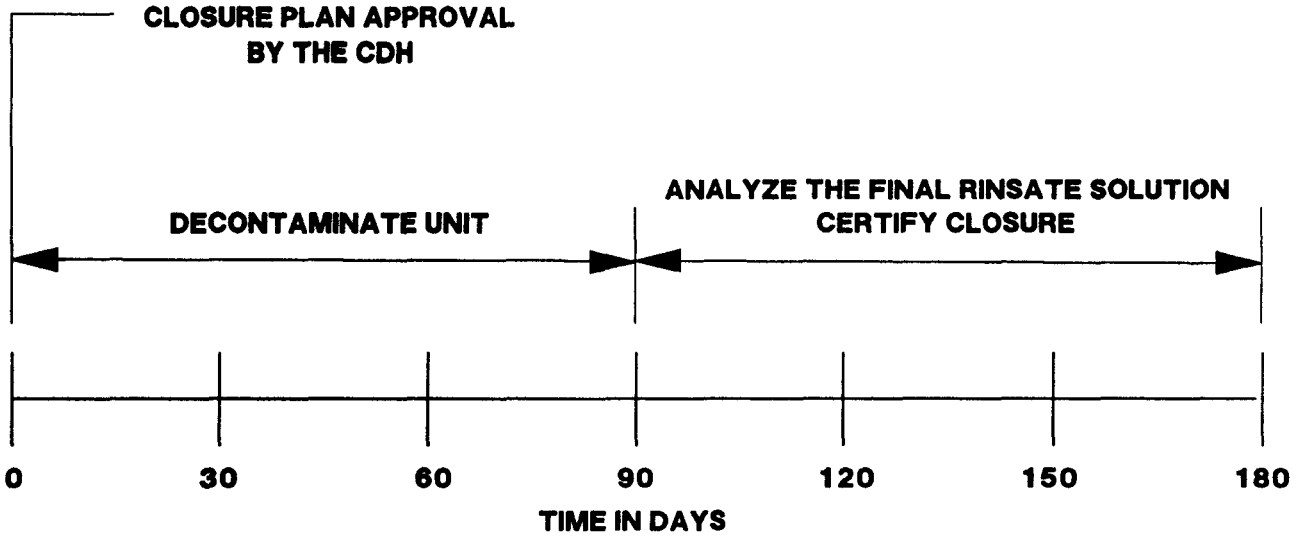
- o Decontamination of soil (if required),
- o Verification of soil decontamination (if required),
- o Performance standard compliance.

All necessary actions will be taken at Pad 904 to ensure compliance with the closure performance standards.

3.3 Closure Schedule

The CDH Director and the EPA Regional Administrator will be notified of the intent to close Storage Pad 904, 45 days prior to the removal of the last waste volume. The closure period will begin when the last shipment of waste leaves Pad 904. Decontamination of the Pad and soil sampling will be accomplished within 90 days from the beginning of closure. The decontamination of equipment will require an additional 10 days. An additional 90 days will be required for the receipt of analytical results.

Assuming the unit and nearby soil is shown to be sufficiently clean after one decontamination round, closure will be certified 180 days after closure operations begin. Figure 31 summarizes the currently anticipated closure activities and schedule. If the analysis of the final rinse solution or soil samples indicates contamination is present above the performance standards, the closure plan will be amended to allow additional time for further decontamination and analysis. If this occurs both the CDH Director and the EPA Regional Administrator will be immediately notified of the delay



SCHEDULE OF CLOSURE ACTIVITIES

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

FIGURE 31

in closure, and documentation supporting the closure period extension will be submitted.

3.4 Administration of the Closure Plan

The interim status closure plan for Storage Pad 904 (SWMU 15 Area A) will be maintained at the Rocky Flats Area Office, Building 111, U.S. Department of Energy. The person responsible for storing and updating this copy of the closure plan is:

David P. Simonson
Manager
U.S. Department of Energy
Rocky Flats Operations (RFO)
P.O. Box 928
Golden, Colorado 80402
Phone: (303) 966-202

4.0 REMOVAL OF HAZARDOUS WASTE INVENTORY

All mixed low-level radioactive and hazardous waste will be removed from Pad 904 Area A by October 1991. This waste will be transported offsite for disposal at the Nevada Test Site (NTS). Until October 1991 the storage of mixed low-level radioactive and hazardous waste will continue at Pad 904.

5.0 OFF-SITE WASTE MANAGEMENT

The only waste residues from closure of this unit requiring treatment/disposal will be rinsate from possible decontamination activities. It is anticipated that the rinsate generated will be treated on-site at the Building 374 treatment facility.

All waste removed from Pad 904 Area A and shipped offsite will be disposed at the Nevada Test Site (NTS). This waste disposal will be covered by the operations and regulations that pertain to NTS. The disposal method will consist of shallow land disposal.

6.0 DECONTAMINATION

6.1 Closure Performance Criteria

Decontamination of Pad 904 Area and all ancillary and cleaning equipment will be conducted until levels of hazardous constituents are found at concentrations less than or equal to those protective of human health and the environment.

Every hazardous constituent identified in Pondcrete or Saltcrete (See Section 2.2.3) was evaluated as a potential decontamination indicator. The hazardous constituents identified in the wastes were broken into groups of hazardous organics, radionuclides or conventional parameters (nitrate). The mobility of the compound in each of these groups was assessed. The most mobile and least mobile compounds were chosen from each group for the indicator list. Mobility was based upon mobility in water, and did not address mobility as a saltating or resuspended particulate.

The rationale for evaluating most and least mobile constituents is so that the greatest extent of any plume as well as source terms can be identified. The most mobile compound can be used to delimit the maximum extent of plume migration; whereas the least mobile compound may remain near the source of contamination and cause a continuing release. If two compounds in the same group had similar mobilities, the compound with the higher concentration in the waste was selected for development of the performance standard.

Mobility was assessed using the distribution coefficient (Kd) with units of liters/kilogram. The distribution coefficient is a measure of the likelihood of a compound to be adsorbed to a soil particle rather than stay in solution. The Kd value represents the

ratio of the amount of a compound adsorbed to soil versus the amount of the compound in water. The greater the distribution coefficient the less mobile the compound in water (Freeze and Cherry 1979). Distribution coefficients were available for radionuclides. The octanol/water partition coefficient was used for organic compounds. The octanol/water partition coefficient (Kow) is an indirect measurement of the distribution coefficient with the compounds being related by a constant for any particular soil (USEPA 1983). The greater the octanol/water partition coefficient the less mobile the compound in water. Table 7 summarizes the mobility evaluation for parameters identified in Pondcrete or Saltcrete.

Table 8 details the hazardous constituents and concentrations that will serve as indicator parameters for decontamination purposes. In general, there are no applicable standards for soil for those compounds listed in Table 8. In cases where no applicable standards for soil exist the partition coefficient or octanol water partition coefficient for the compound was used to establish an acceptable soil concentration. These acceptable soil concentrations are those for which the applicable water standard will not be exceeded based on the distribution coefficient.

With respect to radioactive contamination, the levels of fixed and removable activity will determine if an initial or subsequent decontamination round is required. Decontamination will be considered complete when:

- The direct count does not exceed 250 counts per minute of alpha activity, and

TABLE 7

MOBILITY OF HAZARDOUS COMPOUNDS IDENTIFIED IN SALTCRETE OR PONDCRETE

Compound	Dist. Coefficient (l/kg)	Octanol/Water Part. (unitless)
Nitrate	1 (assumed) (Freeze and Cherry 1979)	---
Acetone	1 (since miscible) (USEPA 1983)	---
Benzene	---	1 EE 2.28 (USEPA 1983)
Bis(2-ethylhexyl)phthalate	---	1 EE 5.3 (USEPA 1983)
2-Butanone	---	1 (USEPA 1983)
Methylene Chloride	---	1 EE 1.3 (USEPA 1983)
Perchloroethylene	---	1 EE 2.88 (USEPA 1983)
1,1,2,2-Tetrachloroethane	---	1 EE 2.3-4.9 (USEPA 1983)
Toluene	---	1 EE 2.07-2.69 (USEPA 1983)
Plutonium-239	1 EE 3.30-6.56 (Nelson, Larsen, Penrose 1984)	---
Americium-241 (Torstenfelt 1986)	1 EE 3.30-6.56 (based upon similarity to plutonium)	

Cyanide, sulfide and uranium were not evaluated due to low concentrations present in the waste.

TABLE 8

DECONTAMINATION INDICATORS

Parameter	Applicable Standard	Concentration	
Nitrate	Drinking Water	10	mg/l
	Acceptable Soil Level	10	mg/kg
Acetone	Detection Limit	5	ug/l
	Acceptable Soil Level	5	mg/kg
BEHT*	Detection Limit	5	ug/l
	Acceptable Soil Level	1000	mg/kg
Plutonium-239	CWQ (see note)	15	pCi/l
	EPA (see note)	13 - 20	pCi/g
Americium-241	CWQ	30	pCi/l
	Proposed TIS	20	pCi/g

* BEHT is Bis(2-ethylhexyl)phthalate

CWQ: Colorado Water Quality Standard, Notice of Final Adoption of Temporary Rule, State of Colorado Water Quality Control Commission, July 11, 1989.

Proposed TIS: Proposed Transuranics in Soil Standard, US Environmental Protection Agency, 1986.

EPA: Interim Guidance: Dose Limits for Persons Exposed to Transuranium Elements in the General Environment. USEPA 1986. (assuming soil bulk density at 1.00 to 1.55 g/cc [Hausenbuiller, 1972])

- o The removable alpha activity does not exceed 20 disintegrations per minute (dpm) per 100 cm2.

6.2 Decontamination of Pad 904

The history of operations at Pad 904 Area A and the runoff samples from this Pad indicate that the Pad must be decontaminated. Since asphalt is a nearly impermeable material, surface cleaning is considered adequate to decontaminate the Pad. The Pad surfaces will be cleaned by one of several commonly implemented methods, including hydroblasting/water wash or foam cleaning. A single wash/rinse cycle is expected to be adequate to decontaminate the Pad. Cleaning Solution E from Table 9, which is effective in removing non-oily mixed wastes, will be used in this operation. The wash and rinsate solutions will be collected by a vacuum unit in the immediate vicinity of cleaning operations as well as along the Pad berms.

Prior to initiation of decontamination activities, a "raw rinsate" sample will be collected for analysis of those hazardous parameters listed in Table 9, and these results will be considered as background levels. Following the decontamination efforts, "used rinsate" samples will be collected and analyzed. The difference in concentration between these two results will be compared to the performance standards listed in Table 8. The unit will meet the performance standards if the adjusted concentration of the "used rinsate" is below the performance standard concentrations. If a single wash/rinse cycle is not adequate to meet the above criteria, the wash/rinse cycle will be repeated until the criteria are met. If the performance standards cannot be met by decontamination as described above, the closure plan for this unit will be amended. If this occurs both the CDH Director and the EPA Regional

TABLE 9

GENERAL PURPOSE DECONTAMINATION SOLUTIONS FOR HAZARDOUS, RADIOACTIVE AND TRU-MIXED WASTES

SOLUTION		PREPARATION DIRECTIONS	SUSPECTED WASTE COMPONENTS
1.	A	To 10 gallons of water, add 4 pounds of sodium carbonate and 4 pounds of trisodium phosphate. Stir until evenly mixed.	Inorganic acids ionic metals
2.	B	To 10 gallons of water, add 8 pounds of calcium hypochlorite and 1/2 pound of sodium hydroxide. Stir with wooden or plastic stirrer until evenly mixed.	Cyanides, other inorganic that are not acidic
3.	C	To 10 gallons of water, add 4 pounds of trisodium phosphate. Stir until evenly mixed.	Solvents, organic compounds, waste oil
4.	D	To 10 gallons of water, add 1 pint of concentrated sulfuric acid slowly while stirring.	Caustic waste
5.	E	"SOLNI" or an equivalent commercially available solution will be used.	Mixed waste, TRU mixed waste (non-oily)
6.	F	Use full strength petroleum ether or similar organic solvent.	Organic compounds
7.	G	Use water.	Dilute organic and inorganic contaminants

Administrator will be immediately notified of the delay in closure, and documentation supporting the extension of the closure period will be submitted.

All sampling/testing of rinsate will be conducted using EPA-approved procedures and minimum detection levels.

To characterize the contamination of radioactive substances, measurements will be taken to determine levels of fixed and removable radioactivity. Total alpha activity levels of the unit will be measured with an air-proportional-type alpha survey meter. Smears will be taken and counted according to plant procedures to determine the level of removable activity. The difference between the air-proportional alpha measurements and the smear activity measurements equals the fixed activity of the location. The levels of fixed and removable activity will determine if the unit requires cleaning, or if it can be used in its current condition.

6.3 Decontamination of Auxiliary Equipment

All auxiliary equipment which was used at Pad 904 Area A will be decontaminated by steam cleaning at the north edge of the Pad. Decontamination will include:

1. A rinse with a steam cleaner using water free of volatile organics.

2. Scrubbing with brushes using a solution of water with Alconox detergent that is free of volatile organics.

3. A final rinse with the steam cleaner using water free of volatile organics.

This work will be done immediately adjacent to the water runoff sample collection berms to minimize the area of the Pad impacted by these operations, and to provide for easy collection of the liquids. This equipment includes forklifts and trucks used for transportation as well as all units used to clean the Pad. Since only storage of the waste on the Pad was conducted, no other equipment need be decontaminated. All wash and rinsate water will be collected and treated on-site at Building 374.

6.4 Decontamination of Equipment Used During Closure

Upon completion of each phase of decontamination required for closure, equipment will be decontaminated by steam cleaning as described in the previous section. All disposable contaminated equipment accumulated during closure will be containerized and shipped to an authorized off-site disposal facility.

6.5 Contaminated Soils

The contaminant concentrations in soils caused by operation of Pad 904 Area A are not expected to be at levels that will require decontamination activities. In addition, contamination was evident in the area of the Pad prior to the construction of the Pad (Section 2.2.5.3). For these reasons no soil decontamination is proposed for the Pad area during closure. These pre-existing conditions will be addressed as a part of the CERCLA activities associated with Pad 903.

6.6 Removal of Hazardous Waste Residues

Approximately 40,000 gallons of wastewater may be generated by decontamination processes. The waste will be collected and placed in tank trucks and this effluent will be transferred to Building 374 for treatment.

7.0 DECONTAMINATION VERIFICATION

7.1 Pad 904

The success of decontamination procedures for Pad 904 Area A and related equipment will be measured by comparing the adjusted concentration of appropriate substances in rinsate with the performance standards listed in Table 8. Testing will be conducted using EPA-approved procedures and minimum detection levels.

In verification tests for water, a "raw rinsate" sample will be collected for analysis of those hazardous parameters listed in Table 8, and these results will be considered background levels. Following the decontamination efforts, "used rinsate" samples will be collected and analyzed for those hazardous constituents listed in Table 8, and the difference in concentration between these two results will be compared to the performance standards listed in Table 8. The unit will be judged to meet the performance standards if the adjusted concentration of the "used rinsate" is below the performance standard concentrations.

Decontamination rinsate sources will be grab-sampled after the preparation of 10,000 gallons of cleaning solution. A wash/rinse is expected to require approximately 40,000 gallons of water. Four samples of the rinsate source will be taken.

One composite sample of the used rinse water will be collected. This sample will be taken as eight separate grab samples from the rinse solution collected in the vacuum unit during the rinse activities. The eight separate grab samples will be composited for analysis.

To verify the decontamination of radioactive substances, measurements will be taken to determine levels of fixed and removable radioactivity. The unit will be considered clean if the direct count does not exceed 250 counts per minute of alpha activity, and the removable alpha activity does not exceed 20 dpm/100 cm^2.

7.2 Surface Water

As discussed in Section 2.2.6.3, South Walnut Creek may potentially be impacted by runoff from Pad 904 Area A. However, the runoff from the Pad quickly leaves the Pad and flows through various ditches and culverts into Pond B-4 and finally pond B-5 where it is monitored prior to offsite discharge. Since these ditches are within areas undergoing CERCLA investigations and since this water must meet NPDES Permit conditions before discharge, it is felt that additional surface water sampling or remediation activities are not warranted following decontamination of the Pad 904 surface.

7.3 Soils

7.3.1 Beneath Pad 904

Degradation of soil beneath the Pad due to storage activities on Pad 904 Area A is not expected due to the low permeability of asphalt and the positive drainage provided by the 0.7 percent slope of the Pad. Cursory visual inspections of the Pad have not identified cracks or other defects from which contaminated materials could reach the environment. However, detailed inspections are not currently possible since large areas of the Pad are covered with stored waste.

When decontamination activities are completed on Pad 904, the Pad will be inspected by an independent registered professional engineer for cracks or other indications that the integrity of the Pad has been compromised. This inspection will include the review of construction and repair records to assess non-visable degredation of the pad. If such an area is identified, these locations will be noted and addressed during the CERCLA activities related to Pad 903.

7.3.2 Adjacent to Pad 904

Soil contamination immediately adjacent to Pad 904 is not expected since all unbermed edges of the Pad have a 0.7% slope toward the bermed areas of the Pad. However, as was stated in Section 2.2.6.3, surface water runoff is believed to have exited the Pad to the east and north prior to the construction of the berms (June 6, 1988). Surface water runoff has also overtopped the berms and exited the Pad to the north following the construction of the berms.

On the basis of this information, soils may be degraded adjacent to the Pad as a result of storage activities at Pad 904 Area A. As presented in Section 2.2.5.3, the magnitude of the degradation due to activities at Pad 904 Area A are minuscule in comparison to the degradation believed to have been caused by activities at Pad 903. For this reason decontamination of soil adjacent to Pad 904 will be addressed as part of the CERCLA activities related to Pad 903.

7.4 Groundwater

As discussed in Section 2.2.6.5, groundwater does not appear to have been impacted by activities at Pad 904 Area A, and as such no groundwater decontamination is warranted. However, sampling of groundwater will continue at those wells presented in Section 2.2.5.4 as part of the ongoing Environmental Restoration Program at the Plant.

7.5 Analytical Methods

The analytical methods to be used in evaluating the success of decontamination efforts, will be those documented in SW-846, or other approved EPA methods. If no approved EPA method is available, then a generally accepted laboratory technique will be used. Fixed and removable radioactivity levels will be analyzed by using an air-proportional-type alpha survey meter (total alpha activity levels) and Smear activity measurements (removable activity).

8.0 CLOSURE SCHEDULE

The CDH and the EPA Regional Administrator will be notified of the intent to close Unit 15 (Pad 904 Area A), 45 days prior to beginning the closure. Decontamination of the unit will be accomplished within 90 days from the beginning of closure. The decontamination of equipment will require 10 additional days. An additional 90 days will be required prior to receiving analytical results.

Assuming the unit is shown to be sufficiently clean after one decontamination round, closure will be certified 180 days after closure plan approval (Figure 31). If the analysis of the final rinse solution indicates contamination is still present above the performance standards, the closure schedule will be extended to allow additional time for further decontamination and analysis.

9.0 CLOSURE COST AND FINANCIAL ASSURANCE

State and Federal governments are exempt from the financial requirements imposed by Subpart H of 6 CCR 1007-3, Section 265.140 (c). Because the Rocky Flats Plant is a federally-owned facility, no cost estimates or financial assurance documentation is required. Cost estimates are presented in Table 10 for planning, budgeting and ınformational purposes. These estimates can in no way be considered binding.

The estimates presented in Table 10 are based on a worst case scenario in which the entire unit undergoing closure is found to be contaminated. These assumptions are expected to result in an overestimation of the actual costs that will be incurred, since this unit is expected to be clean. These estimates do not include the cost of reprocessing, repackaging, shipping or offsite disposal of Pondcrete or Saltcrete.

TABLE 10

COST ESTIMATE FOR CLOSURE OF UNIT 15

Engineering Design and Inspection	$15,000.00
Equipment	30,000.00
Decontamination Monitoring	5,000.00
Treatment/Disposal	6,400.00
Contingency	8,000.00
TOTAL	$64,400.00

10.0 SITE ACCESS AND SECURITY

Access to the work area will be limited to authorized personnel only. Exit from the working area will be through a clean, restricted area in the decontamination area. Existing security measures at the Rocky Flats Plant meet the requirements of 6 CCR 1007-3, Section 265.14. These include:

- A three-strand barbed-wire cattle fence surrounding the facility posted to identify the land as a government reservation/restricted area,
- A fence and armed guards posted 24 hours daily at two gates to the controlled area of the facility, and
- Surveillance by security cameras 24 hours daily.

Existing fences and gates are operated and maintained by DOE. Maintenance requirements will be performed by DOE regardless of closure activities at the site.

11.0 HEALTH AND SAFETY

A site-specific Health and Safety Plan covering decontamination of the site, will be prepared two months before closure activities begin. The plan will comply with all Occupational Safety and Health Administration (OSHA), CDH, EPA, and DOE requirements.

12.0 POST-CLOSURE MONITORING

The implementation of post-closure monitoring is not necessary due to the contained nature of the container storage area.

13.0 CLOSURE CERTIFICATION

After completion of closure, the owner or operator and an independent certified registered engineer will submit certification of closure, based upon compliance with the closure plan, to the CDH and the EPA Regional Administrator.

The independent registered professional engineer will periodically review the closure operations in enough detail to assure final certification of closure. The final certification of closure will state that the closure procedures and standards have been carried out as described in the approved closure plan. In order to certify the performance and completion of closure activities, the independent registered professional engineer will review test results and inspect the site to verify the closure plan was carried out as approved. Both the operator and the independent registered professional engineer will submit a written document to the CDH and the EPA Regional Administrator to certify closure activities were conducted in accordance with the approved closure plan.

14.0 REFERENCES

Colorado Water Quality Control Commission. July 11, 1989. Colorado Water Quality Standard, Notice of Final Adoption of Temporary Rule.

Freeze, R. A. and J. A. Cherry. 1979. Groundwater. Prentice Hall Inc., Englewood Cliffs, New Jersey.

Nelson, D. M., R. P. Larsen and W. R. Penrose. 1984. "Chemical Speciation of Plutonium in Natural Waters," Symposium on Environmental Research for Actinide Elements. Conf-8311110-5, DE84 014761.

Rockwell International Corporation. 1988. Resource Conservation and Recovery Act Part B - Operating Permit Application: Rocky Flats Plant Transuranic (TRU) Mixed Wastes. Volumes I through V. U.S. Department of Energy, Golden, Colorado.

_____. 1986. RCRA Part B - Operating Permit Application for USDOE-Rocky Flats Plant. Hazardous and Radioactive Mixed Waste. CO7890010526. November 1, 1986. Section E - Groundwater Monitoring and Protection.

_____. 1986. Geologic and Hydrologic Data Summary. USDOE-Rocky Flats Plant. Golden, Colorado. July 21, 1986.

Torstenfelt, B. 1986. "Migration of the Actinides Thorium, Protactinium, Uranium, Neptunium, Plutonium and Americium in Clay," Radiochimica Acta. Volume 39, 105-112.

U.S. Environmental Protection Agency. 1983. Hazardous Waste Land Treatment Manual. SW-874.

_____. 1986. Proposed Guidance on Transuranic Compounds in the Environment. Revised Draft. Evaluating Solid Wastes. Third Edition. SW-846.

_____. 1986a. Test Methods for Evaluating Solid Wastes. Third Edition. SW-846.

_____. 1985. Office of Health and Environmental Assessment. Rapid Assessment of Exposure to Particulate Emmissions from Surface Contamination Sites. February 1985. EPA/600/8-85/002

_____. 1982. Environmental Criteria and Assessment Office. Air Quality Criteria for Particulate Matter and Sulfur Oxide. December 1982. EPA-600/8-82-029. Vol C.

Denver Regional Council of Governments (DRCOG). 1969. Urban Storm Drainage Criteria Manual. Vol. 1. Prepared by Wright-McLaughlin Engineers. March (Revised 5/1/84).

U.S. Soil Conservation Service (SCS). 1977. Procedures for Determining Peak Flows in Colorado. U.S. Department of Agriculture. March.

Rockwell International. 1987. Remedial Investigation Report for 903 Pad, mound, and East Trenches Areas (Draft). Report prepared for the U.S. Department of Energy, Rocky Flats Plant, Golden, Colorado. 31 December, 11 Volumes.

U.S. Environmental Protection Agency (EPA). 1986c. Interim Guidance: Dose Limits for Persons Expenses to Transuranium Elements in the General Environment.

Colorado Department of Health (CDH). 1989a. Meeting with Rocky Flats Plant Personnel, January 13, 1989.

_____. 1989b. Letter from Gary W. Baughman (CDH) to Albert E. Whiteman (Rockwell International), April 24.

Hausenbuiller, R.L. 1972. Soil Science Principles and Practices. W.C. Brown Publishing Co.

Rockwell International. 1989 1988 Annual RCRA Ground Water Monitoring Report for Regulated Units at Rocky Flats Plant. Volume 1 Test and Appendices. 1 March.

Wedding, Et Al. 1984. Determination of Filtration Efficiency of the S and S Fiber Filter.

Wedding, J.B., Carney, T.C.. 1978. Determination of Sampling Effectiveness of the Rocky Flats High Volume Sampler and Filtration Efficiency on Micro Sorban-98 Fiber Fluid.

Schiuler, Schuell. 1982. Innovative Products for Separation Science. Publication Number 500.

APPENDIX A

PRODUCTION PROCESS DESCRIPTION FOR PONDCRETE AND SALTCRETE FROM SECTION D OF RCRA PART B PERMIT

NOTE

This appendix consists of information found in the RCRA Part B Permit Application for the Rocky Flats Plant. This information has been updated to accurately reflect the current situation.

effluent from the third stage clarifier is transferred to Tanks D-826 A and B after passing through a Baker Precoat Pressure Filter, FL-831. This filter accomplishes a final solids separation. Filter backwash is transferred to the Filter Feed Tanks D-824 A and B for treatment as TRU waste.

The radioactivity level in the clarifier effluent holding tanks is sampled to determine whether the solution can be sent to the evaporator feed tank or needs to be returned to Tanks D-804A, B, C, or D for recycling through the decontamination-precipitation system. Flow through the system is regulated by a series of Flow Controllers and Ratio Controllers, which adjust pump speeds and addition of reagents.

D-2c(2)(e) Evaporation Process

The evaporation system consists of a multiple effect steam heated unit which produces condensate water and a concentrated salt solution which is fed to the spray dryer. The process includes the following equipment:

Feed Tank D-827

Feed Pumps P-818A, B

In-line Filters FL-801A, B

Vapor Bodies T-802, T-803, T-804, T-805

Heat Exchangers E806A, B, E-807, E-808, E-809

Circulating Pumps P-819, P-820, P-821, P-822

Condenser E-810

Flash Tanks D-830, D-832, D-876

Condensate Tank D-834

Product Water Pumps P-824, P-825

Ejectors J-801, J-803

Ejector Aftercooler E-820

Ejector Condensate Tank D-879

Tower Water Return Pump P-861

~~Nitrate Analyzer~~

Heat Exchanger Descaling Tank D-845

Evaporator Concentrate Storage D-826C

Spray Dryer Feed Tank D-878

Feed Pumps P-858A, B

Spray Dryer Furnace F-801

Spray Atomizer

Spray Drier Drying Chamber W-803

Bag Filter FL-803

HEPA Filter Plenums FL 804A, B

Evaporator Effluent Tanks T-808A, B

Salt Crete Transfer Tank T-884

Salt Crete Mixing Tanks T-883A, B

- Evaporator Feed

  The evaporator feed tank, D-827, receives waste water from Tanks D-801A, B, C; D-802A, B, C; and D-826A and B. The feed solution from Tanks D-801 A,B, and C and D-802 A, B, and C pass through in-line filters FL801A and B before entering D-827. These filters (bucket strainers)

are periodically flushed out down a process sink to Sump D-852.

- Multiple Effect Evaporation Process

  From the feed tank, the solution is pumped into the first effect of the evaporator through the feed preheater. Heat is transferred to the feed from the steam condensate coming from the first effect heat exchanger. Circulation Pump P-819 continuously circulates the liquid in the first effect by drawing liquid from the bottom of the first effect vapor body (T-802), pumping it through the first effect heat exchanger (E-806A or B), and discharging it near the liquid level in the first effect vapor body. The circulation rate is approximately 20 times the evaporator throughput at the design feed rate. Heat exchanger E-806A or B uses 30 psig steam to heat the first effect liquid. Water which evaporates in the first effect passes through the second effect heat exchanger (E-807) to heat that effect, and is collected in Flash Tank D-830. The partially concentrated liquid remaining in the first effect continuously feeds to the second effect.

  The liquid in the second effect circulates in the same manner as in the first effect. The evaporated water from the second effect goes through the third effect heat exchanger to heat that effect and collects in Flash Tank

D-832. The second effect concentrate continuously feeds the third effect.

The third and fourth effects operate in the same manner. Water which evaporates in the fourth effect condenses in the main surface condenser E-810 and collects in Condensate Tank D-834. The concentrated liquid remaining in the fourth effect is continuously pumped to Tanks D-826C or D-878. The liquid in Tank D-826 C can be transferred either to Tank D-878 or to the Salt Crete mixing station. Tank D-878 feeds the spray dryer system.

Nitric acid, phosphoric acid and water are circulated on the process side of the heat exchangers through the heat exchanger descaling tank, D-845. When the acid is depleted, this tank is drained to Tanks D-807A and B for neutralization, or tanks D-824 A & B.

Two parallel steam ejectors (J-801 and J-803) provide the vacuum necessary to maintain and develop the evaporator pressure profile. The pressures range from approximately 10 psig in the first effect to a vacuum of about 20 in. Hg in the fourth effect. Both ejectors evacuate the system during startup, but only one is used during steady state operation. The exhaust steam from the ejectors condenses in the ejector aftercooler (E-820) by contact with water from Cooling Tower 373. The condensate and tower water drain to Tank D-879 and are pumped back to

the cooling tower by Pump P-861.

The condensate water from the flash tanks and the condensate tank is pumped to the raw water supply for nine cooling towers.

Verification that waste treatment is complete is provided by sampling of the nitrate salt and product water on a weekly basis. Product water is also continuously monitored for conductivity, which is an indication of high dissolved solids or ammonia concentration. High conductivity automatically causes the evaporator effluent to be rerouted back to Tank D-802 A, B, or C or to the evaporator feed tank D-827. The waste sampling and analysis plans provided in Section C address this in more detail.

- Spray Dryer System

  The concentrated salt solution (approximately 35 percent dissolved salts) is pumped from Tank D-826C into D-878, the spray dryer feed tank. From there the material is pumped to the spray atomizer by Feed Pumps P-858A and B, via Flow Controller FIC-7877. A pressure relief valve is mounted in the pump discharge line to relieve excess pressure.

The spray atomizer consists of a 25 KW frequency converter set, a high speed motor, and a centrifugal atomizer. The concentrate solution is atomized by the centrifugal atomizer into a hot air stream in the Spray Dryer, W-803.

The spray dryer furnace (F-801) heats air with a combination gas-oil burner which fires directly into the air stream in a horizontal heater shell. Cold air enters at the base of the heater shell tangential to the burner, combines with the flame, and is thoroughly mixed to an even temperature as it passes through the air duct and enters the drying chamber. Natural gas is the normal fuel with fuel oil used as a backup. Combustion products enter directly into the spray dryer air stream.

Heated air from the furnace enters the drying chamber (W-803) through a set of downward vanes concentric with the salt concentrate from the spray machine. Instantaneous drying occurs creating small spherical salt particles suspended in the air stream. The water evaporating from the solution cools the air to maintain an outlet temperature of approximately 140°C.

o Bag Filter Product Collector FL-803

From the spray dryer, salt-laden air passes into the bag filter house where a series of ~~cloth~~ Gore-Tex, fiberglass impregnated filter bags separate the salt from the air stream. Pulses of compressed air blow downward through the filter bags to dislodge accumulated salt and drop it to the bottom of the collector. The dry product then passes through a rotary air lock into a receiving transfer tank (T-884) then into two Salt Crete mixing tanks, T-883 A and B. The frequency of the air pulse jet is regulated to maintain the desired operating conditions and pressure drop across the baghouse.

The clean air from the bag filter passes through two High Efficiency Particulate Air (HEPA) filter plenums, FL-804A and B, which remove trace amounts of salt, and is then released to the atmosphere.

o Salt-Crete Operation

Dry salt product from the bag filter is mixed in Tanks T-883 A and B with Portland Cement and either a portion of the concentrated salt solution from Tank D-826 C, domestic water, raw water, or Building 374 effluent water. This cemented product, called Salt Crete, is allowed to set up in ~~trimall/fiberboard~~ plywood boxes lined with plastic.

D-2d(2) Treatment Facilities

One location has been identified in which hazardous wastes are treated in tanks and an operating permit under RCRA is required. This is in addition to the treatment tanks described as part of the waste treatment system. Following are detailed descriptions of the treatment processes occurring in tanks. Engineering drawings are provided in Appendix D-5.

D-2d(2)(a) Original Uranium Chip Roaster: Building 444/447 (Unit 45)

Deleted - See Record of Amendments.

D-2d(2)(b) New Chip Roaster: Building 444/447 (Unit 46)

Deleted - See Record of Amendments.

D-2d(2)(c) Electrolyte Recovery Process: Building 460 (Unit 47)

Deleted. See Record of Amendments.

D-2d(2)(d) Pond Crete Solidification Process: Building 788 (Unit 48)

The Building 788 sludge thickener and solidification system at the solar pond consists of a Mud Cat pumper with an agitator and a pump on pontoons which pumps the sludge from a solar pond 207A into the 25,000-gallon steel Gardner Denver/Stearns Roger thickener tank. A rake enclosed in the base of the tank directs the sludge to a drain at the bottom of the tank. After the settling process is completed (10-12 hours), the liquid is

decanted from the tank back into the pond. The thickener is designed to allow a continuous overflow passing over an adjustable weir and flowing through a 4 in. diameter pipe discharging into Pond 207A. The thickener is vented to the atmosphere.

The sludge is then pumped from the base of the tank by a high pressure diaphragm slurry pump through steel piping to the back end of the steel "pug mill". Table D-11 lists specifications for the thickener and pug mill. A series of surge pins, screw augers and paddle wheels lift and mix the sludge with portland cement, which is fed in from an adjacent silo. The mixed sludge and cement, called Pond Crete, flows over a weir, through a chute and into boxes. The plywood boxes lined with 0.011 inch plastic are filled with Pond Crete, dated, and stored in the Building 788 warehouse. Pond Crete storage is discussed in sections D-1b(2), (g), and (j).

The thickener unit's foundation design is not intended to provide any containment capacity for spill control. Instead, it is designed to have a proper slope and configuration so that the entire thickener content would be allowed to flow back to Pond 207 A in the event of tank leakage or puncture. The foundation is constructed of concrete which is free of cracks and gaps.

TANK INFORMATION TABLE
POND CRETE TANKS

TABLE D-11

PERMITTED UNIT NUMBER	48 01	48 02
TANK NUMBER	N/A	N/A
TANK NAME	Thickener	Pug Mill
BUILDING NUMBER	788	788
DESIGN STANDARDS	ASME	Commercially avail. equip.
MATERIAL OF CONSTRUCTION	Carbon Steel	Carbon Steel
WASTE CONTAINED	Pond water/sludge, pH 11	Thickener bottoms, pH 11
CORROSION ALLOWANCE	N/A	N/A
DIMENSIONS (dia x h)	25'0" x 9'6"	12" trough,7'8" long
CAPACITY (gal)	35,000	90
SHELL THICKNESS	shell 1/4", core 5/16"	1/4"
OPERATING PRESSURE	Atm	Atm
OPERATING TEMPERATURE	Amb	Amb
DESIGN PRESSURE	N/A	N/A
DESIGN TEMPERATURE	N/A	N/A
MAXIMUM LIQUID LEVEL	7'10"	N/A
SPECIFIC GRAVITY	1.08	1 17
STRUCTURAL SUPPORTS	6 steel channel legs	Structural steel stand
YEAR OF CONSTRUCTION	1984	1984
SEAM TYPE	Full Penetration Butt Weld	Welded and Bolted
PFD DRAWING NUMBER	D-850	D-850
P&ID DRAWING NUMBER	D-852	D-852
TANK DRAWING NUMBER	D-851	D-851
FLOOR PLAN DRAWING NUMBER		
SECONDARY CONTAINMENT UNIT	2053	2053

* - Horizontal tank (n = length)

The pond sludge characterization is detailed in Section C, "Waste Characterization and Analysis".

- Additional Temporary Solar Pond Equipment

  To increase the capacity of the Pond Crete production operation, additional equipment has recently been purchased. The major pieces of additional equipment are a concrete batch mixer and a front end loader. The concrete mixer (4.0 cubic yards), receives a transfer of four cubic yards of concentrated pond sludge from the existing thickener. The sludge is transferred by an existing pump through a two inch diameter line at 25 gpm. Portland cement is then pneumatically transferred to the mixer by a portable cement silo and pneumatic transfer system. The cement and sludge is then mixed by rotating the mixer. The mixture is then discharged into a lined plywood box.

  The front end loader will be used to transfer sludge from the bottom of the solar pond and dump it into a new concrete pumper for transfer to the thickener. The front end loader is also used to move sludge from the shallow end of the pond to the deep end.

APPENDIX B

BORING LOGS FOR WELLS IN THE AREA OF PAD 904

Major Divisions		Letter	Hatching	Name
Coarse-grained Soils	Gravel and Gravely Sands	GW		Well graded gravels or gravel-sand mixtures little or no fines
		GP		Poorly graded gravels or gravel-sand mixtures little or no fines
		GM		Silty gravels gravel-sand-silt mixtures
		GC		Clayey gravels gravel-sand-clay mixtures
	Sand and Sandy Soils	SW		Well-graded sands or gravelly sands little or no fines
		SP		Poorly-graded sands or gravelly sands little or no fines
		SM		Silty sands sand-silt mixtures
		SC		Clayey sands sand-clay mixtures
Fine-Grained Soils	Silts and Clays (LL < 50)	ML		Inorganic silts and very fine sands rock flour silty or clayey fine sands or clayey silts with slight plasticity
		CL		Inorganic clays of low to medium plasticity gravelly clays sandy clays silty clays lean clays
		OL		Organic silts and organic silt-clays of low plasticity
	Silts and Clays (LL > 50)	MH		Inorganic silts micaceous or diatimaceous fine sandy or silty soils elastic soils
		CH		Inorganic clays of high plasticity fat clays
		OH		Organic clays of medium to high plasticity organic silts
Highly Organic Soils		PT		Peat and other highly organic soils

SAMPLE TYPE

TEST TYPE

CHEMICAL

UNIFIED SOIL CLASSIFICATION SYSTEM AND BORING LOG SYMBOLS

BORING LOGS FOR ALLUVIAL WELLS

24-86	4-87
26-86	10-87
33-86	15-87
61-86	44-87

LOG OF BORING No. 24-86

Page 1 of 1

DATE DRILLED: 9/12/86 EQUIPMENT: MOBILE B-57

DESCRIPTION HSA ELEVATION: 5980.45

DRILLING CONTRACTOR _____

DRILLER _____

BY _____ CHK'D BY _____

DATE _____

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
	60	25 / 20	1			Gravel Yellow-gray (5y 7/2) to light olive gray (5y 5/2), some granitic pebbles, coarse sand and silt with a trace of clay, dry	
			2				
	36	25 / 09	3			As Above	
			4				
			5				
	0	20 / 0	6			No Recovery	
			7				
	100	50 / 50	8			Claystone Pale olive (10y 6/2) to green gray (5Gy 6/1), silty with some fine-grained sand, claystone contains dark yellow orange (10yr 6/6) iron staining, calcareous pockets along fractures throughout sample, damp	
			9				
			10				
			11				
			12				
			13			Total depth of borehole= 12 FT	
			14				
			15				
			16				
			17				
			18				
			19				
			20				

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

ROCKY FLATS PLANT

PAD 904 CLOSURE

PROJECT NO xx -xx

LOG OF BORING No. 26-86

Page 1 of 1

DATE DRILLED 8/22/86 EQUIPMENT MOBILE B-57

DESCRIPTION ESA ELEVATION: 6074 48

DRILLING CONTRACTOR Boyles Brothers Drilling Co

DRILLER D JARVIE

BY LAA

DATE 6/14/89 CHKD BY

SAMPLE NO. / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
	87	18 / 13	1			Sandy, Silty Gravel Light brown, (5YR 6/4), granite and quartzite, angular to subangular cobbles and pebbles Poorly sorted dry	
	0	24 / 0	2				
			3				
	87	30 / 28	4				
			5			Clayey Sand Very pale orange, (10YR 8/2), to grayish orange (10YR 7/4) Very fine grained Some granite and quartzite pebbles and cobbles Medium plasticity Grades to very clayey dark yellow orange, (10YR 6/6) sand with large cobbles at base of sample Poorly sorted, subangular to angular Low to medium plasticity, damp	
			6				
	0	20 / 0	7				
			8				
	100	30 / 30	9				
			10			Claystone Light olive brown, (5Y 5/6), some silt, trace sand Sand layers from 10 4-10 7 and 11 4-11 6 Sand is very pale orange, (10YR 8/2) coarse grained, moderately sorted subangular, trace calcareous cement Unconsolidated soft, wet Clay is firm moist	
			11				
	100	50 / 50	12				
			13			Claystone Medium dark gray (N4) with grayish orange (10YR 7/4) and pale olive (10YR 6/2) mottling Some silt with very coarse grained sand lenses, less than 0 2 thick Ironstone layer at 12 9-13 2 with calcareous cement Firm, moist	
			14				
			15				
			16				
			17			Total Borehole Depth 17 0 ft	
			18				
			19				

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

26-86

ROCKY FLATS PLANT

PAD 904 CLOSURE

PROJECT NO 887-10

LOG OF BORING No. 33-86

Page 1 of 1

DATE DRILLED: 9/10/86 EQUIPMENT: MOBILE B-57

DESCRIPTION: BRA ELEVATION: 5949.28

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
	88	4.8 / 3.1	1			Clayey Gravel Light olive gray, (5Y 3/2) Some sand, silt and poorly sorted quartzite pebbles Subangular Crumbly, dry	
			2				
			3				
			4				
	100	2.0 / 2.0	5			Clayey Gravel Light olive gray, (5Y 5/2) Some sand quartzite cobbles and gravel clasts Angular to subangular Moderate sorting Loose, dry	
			6				
						TOPSOIL/SOIL	
	100	5.0 / 5.0	7			Claystone Grayish yellow green, (5 GY 7/2) to grayish olive green, (5GY 3/2) with olive gray, (5Y 3/2) to greenish gray, (5GY 6/1) and dark yellowish orange, (10YR 6/6) stains Well sorted, consolidated, fractured firm, weathered, damp	
			8				
			9				
			10				
			11				
	100	5.0 / 5.0	12				
			13				
			14				
			15				
			16				
			17			Total Borehole Depth 16 8 ft	
			18				
			19				

DRILLING CONTRACTOR: Boyles Brothers Drilling Co.

DRILLER: D. MARVE

LOGGED BY: TMK

DATE: 6/20/89

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING. SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

ROCKY FLATS PLANT

PAD 904 CLOSURE

PROJECT NO 867-10

LOG OF BORING No. 61-86

Page 1 of 1

DATE DRILLED 11/19/86 EQUIPMENT MOBILE B-57

DESCRIPTION RSA ELEVATION 6090.31

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	
	80	2.5 / 2.0	1			Clayey Gravel Dark yellowish brown, (10YR 4/2) Abundant small cobbles Moist
			2			
	88	2.5 / 2.2	3			Caliche Yellowish gray, (5Y 8/1) to white (N9) Abundant CaCO3 some sand
			4			
	62	6.5 / 4.0	5			
			6			Clayey Gravel Dark yellowish brown, (10YR 4/2) Caliche intermixed iron stains at 8.5'-11.5 Moist
			7			
			8			
			9			
			10			
			11			TOPSOIL/SOIL
			12			Claystone Dark yellowish orange, (10YR 6/6) Moderate to high plasticity Undisturbed moist
			13			
	80	5.0 / 4.0	14			Silty Claystone Dark yellowish orange (10YR 6/6) to light olive gray, (5Y 6/1) Friable moist
			15			
			16			
			17			
			18			
			19			Total Depth of Borehole 18.5 ft

DRILLING CONTRACTOR Boyles Brothers Drilling Co

DRILLER J HORN

BY JAA

DATE 5/20/89 CHKD BY

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

ROCKY FLATS PLANT

PAD 904 CLOSURE

PROJECT NO 667-10

LOG OF BORING No. 4-87

Page 1 of 2

DATE DRILLED: 5/11/87 EQUIPMENT:

DESCRIPTION BSA ELEVATION. 5909.79

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	
	93	25 / 23	1–2			Clay Moderate brown (5yr 2/2), some very fine grained sand, occasional quartzite cobbles, some grasses, moist to damp
	84	25 / 21	3–5			Clay Dusky yellow-brown (10yr 2/2) to dark yellow-brown (10yr 4/2), small quartzite cobbles (up to 2-inch diameter), some fine-grained sand moist to damp
	86	50 / 4 28	6–10			Sand and Gravel Moderate yellowish brown (10yr 5/4) to dark yellowish brown (10yr 4/2), some clay-rich fine-grained sand, some sub-rounded to subangular quartzite cobbles and pebbles, calache (8 28'–8 36') very pale orange (10yr 8/2) to gray-orange (10yr 7/4), moist to wet
	81	30 / 2 44	11			Sandy Clay Moderate yellow-brown (10yr 5/4), fine-grained sand, occasional subrounded to subangular quartzite cobbles and pebbles moist to wet
			12			Sand and Gravel Light brown (5yr 5/6), subrounded quartzite cobbles, moist to wet
	103	30 / 3 1	13			Clay Light olive gray (5yr 5/2) with patches of dark yellow-orange (10yr 6/6) angular quartzite some brown sands and clays, wet
			14			Gravel Dark yellowish orange (10yr 6/6), angular quartzite, some brown sands and clays, wet
			15			Clay Dark yellow-orange (10yr 6/6) and light olive gray (5yr 5/2), subrounded quartzite cobble at 14 6', moist to damp
	98	20 / 1 95	16–17			Sandy Clay Moderate yellow-brown (10yr 5/4), subangular quartzite cobbles and pebbles, moist to slightly damp
	81	25 / 2 1	18–19			
			20			Claystone Light olive gray (5y 5/2)

DRILLING CONTRACTOR _____

DRILLER _____

BY _____

CHKD BY _____

DATE _____

TESTS

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

4-87B

ROCKY FLATS PLANT

PAD 904 CLOSURE

PROJECT NO xxx-xx

LOG OF BORING No. 4-87

DATE DRILLED: 5/11/87 EQUIPMENT:

DESCRIPTION: BSA ELEVATION: 5909.79

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLE	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
			20			Claystone Disturbed, weathered, slightly damp	
	83	30 / 25	21			As Above- Dark yellow-orange (10yr 6/6) iron stains, wet at 20 5' to 20 65', damp to slightly moist 21 2' to 22 01' and dry from 22 01' to 23 0'	
			22				
			23				
			24			Total depth of borehole= 23 0'	
			25				
			26				
			27				
			28				
			29				
			30				
			31				
			32				
			33				
			34				
			35				
			36				
			37				
			38				
			39				
			40				

DRILLING CONTRACTOR _____

DRILLER _____

BY _____ CHK D BY _____

DATE _____

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING. SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

ROCKY FLATS PLANT

PAD 904 CLOSURE

PROJECT NO xxx-xx

LOG OF BORING No. 10-87

Page 1 of 1

DATE DRILLED 6/18/87 EQUIPMENT MOBILE B-57

DESCRIPTION ESA ELEVATION 6081.96

DRILLING CONTRACTOR Boyles Brothers Drilling Co

DRILLER L Pivonka

BY CK-F

DATE 6/8/89 CHKD BY MW

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	DESCRIPTION
	50	20 / 10	1			Sandy Clay Moderate brown, (5YR 4/4) Numerous quartzite pebbles and cobbles, some roots dry
	30	20 / 06	2 3			Gravel Quartzite pebbles and cobbles dry
	0	0 / 0	4			No recovery
	100	20 / 20	5 6			Sandy Clay Light olive gray (5Y 6/1) to moderate reddish orange, (10R 6/6) Numerous quartzite pebbles and cobbles Highly weathered calcite throughout Unconsolidated, damp
	100	20 / 20	7 8			Clayey Sand Light gray, (N 7/0) to moderate reddish orange, (10R 6/6) Numerous quartzite pebbles, subangular to subrounded Caliche throughout Damp to dry
	75	20 / 15	9 10			Sand Moderate reddish orange, (10R 6/6) Medium to coarse grained Numerous quartzite pebbles Trace calcite Weathered, damp
	100	20 / 20	11 12			Silty Claystone Moderate reddish orange (10R 6/6) Iron staining, light gray areas (N 70) Moderate plasticity Damp to dry
	100	20 / 20	13 14			Sandy Silty Claystone Moderate reddish orange, (10R 6/6) Iron staining light gray areas (N 70) Moderate plasticity Damp
	100	20 / 20	15 16			Sand Light gray (N 7/0) to moderate reddish orange, (10R 6/6) Very fine Trace calcite Dry to damp
			17 18 19			

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

10-87

ROCKY FLATS PLANT

PAD 904 CLOSURE

PROJECT NO 867-10

LOG OF BORING No. 15-87

Page 1 of 2

DATE DRILLED 6/16/87 EQUIPMENT:

DESCRIPTION HSA ELEVATION. 5970.89

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	TESTS
	55	20 / 11	1			
	100	14 / 14	2			
			3			
BH 30870010	0					
	40	30 / 12	4			
			5			
			6			
	77	15 / 15	7			
			8			
BH 30870015	0					
	54	25 / 35	9			
			10			
			11			
	48	25 / 12	12			
			13			
	35	20 / 07	14			
			15			
	29	4 / 15	16			
			17			
			18			
			19			
			20			

Sandy Gravel Dark yellow-brown, (10YR 4/2) Quartzite pebbles and cobbles trace of clay, fine-grained sand, pooly sorted,roots and grasses, dry

As Above - Orange-pink (5yr 8/4), No roots or grasses

Sandy Gravel Light brown (5yr 5/6), Quartzite cobbles and pebbles, trace clay fine-grained sand, some caliche [very pale orange (10 yr 8/2)] damp to dry

As Above - No caliche, dry

As Above - Damp

DRILLING CONTRACTOR

DRILLER

CHK D BY

BY

DATE

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

15-87

ROCKY FLATS PLANT

PAD 904 CLOSURE

PROJECT NO xxx-xx

LOG OF BORING No. 15-87

DATE DRILLED: 6/16/87 EQUIPMENT

DESCRIPTION BSA ELEVATION 5070 89

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	TEST DRIVEN / TEST SAMPLE	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
BH 30870010	126	26 / 26	21			Gravel Light brown (5yr 5/6), Some sand, quartzite cobbles and pebbles, wet.	
	88	26 / 22	22			Claystone Light olive gray (5yr 5/2), Moderate reddish orange (10yr 6/6) iron stained patches damp to moist	
BH 30870015	106	26 / 26 6	23				
			24				
			25				
			26				
			27			Total Depth of Borehole = 27 0 ft	
			28				
			29				
			30				
			31				
			32				
			33				
			34				
			35				
			36				
			37				
			38				
			40				
			20				

DRILLING CONTRACTOR

DRILLER

CHK D BY

BY

DATE

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 44-87

Page 1 of 1

DATE DRILLED: 10/8/87 EQUIPMENT:

DESCRIPTION HSA ELEVATION. 5949.53

DRILLING CONRACTOR T HIGH

DRILLER

BY CHK'D BY

DATE

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLE	DEPTH IN FEET	WELL OR PIEZO-METER CON-STRUCTION	GRAPHIC LOG	
BH 588700UC	85	20 / 17	1			Topsoil Black-red (5yr 2/2).
						Silty Clay Dark yellow orange (10yr 6/6), Dense, caliche, damp
BH 588702 CT	95	20 / 19	2			▽ 11/87 Clay Olive gray (5yr 4/1) and dark yellow brown (10yr 4/2), weakly layered, very dense, oxadized, abundant, calache, well consolidated, damp
			3			
			4			Claystone Brown gray (5yr 4/1), consolidated slightly damp
BH 588704	103	30 / 31	5			
			6			Silty Claystone Yellow brown (10yr 5/4) to dark yellow orange (10yr 6/6), oxadized, damp
			7			
			8			Total Depyh of Borehole 7 0 Ft
			9			
			10			
			11			
			12			
			13			
			14			
			15			
			16			
			17			
			18			
			19			
			20			

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

ROCKY FLATS PLANT

PAD 904 CLOSURE

PROJECT NO xxx-xx

BORING LOGS FOR BEDROCK WELLS

23-86BR	9-87BR
25-86BR	16-87BR
25-86BR	16-87BR
5-87BR	45-87BR

LOG OF BORING No. 23-86BR

Page 1 of 7

DATE DRILLED: 9/11-25/86 EQUIPMENT: MOBILE B-57

DESCRIPTION: BRA ELEVATION: 5081.18

DRILLING CONTRACTOR: Boyles Brothers Drilling Co

DRILLER: D JARVIE

LOGGED BY: LAA CHKD BY:

DATE: 6/23/89

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	DESCRIPTION	REMARKS
	80	2.5 / 1.6	1			Gravel Reddish brown, (10R 5/4) to light olive gray, (5Y 5/2) Sand, silt and pebbles, some quartzite cobbles Calcareous, poorly sorted, angular, unconsolidated, dry	
	48	2.5 / 1.2	3			Gravel Yellowish gray (5Y 8/4) Sand, silt and pebbles Calcareous poorly sorted angular damp	
	36	2.0 / 0.7	5			Gravel Pale olive, (10Y 6/2) Granite and quartzite pebbles some sand, trace clay and silt Calcareous, poorly sorted compacted, damp	
	68	2.5 / 1.7	7			TOPSOIL/SOIL	
			8			Silty Claystone Pale olive, (10Y 6/2) Calcite along fractures at 8.5, 9.0 and 9.5 Some dark yellowish orange, (10YR 6/6) staining Firm, damp	
	100	2.5 / 2.5	10			Claystone Yellowish gray to greenish gray (5Y 7/2 to 5GY 6/1) Sandy and silty in upper 1.5 increasing in clay content with depth, some dark yellowish orange (10YR 6/6) iron staining Ironstone at 10.5 Calcareous layers at 9.5 and 10.7 Firm damp	
	100	5.0 / 5.0	12			Silty Claystone Light olive gray, (5Y 5/2) to olive gray, (5Y 3/2) Calcareous layer at 13.5 Firm damp	
	100	5.0 / 5.0	17			Silty Claystone Light olive gray, (5Y 5/2) Trace calcite at 18.1, trace dark yellowish orange (10YR 6/6) iron staining Firm damp	

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING. SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

LOG OF BORING No. 23-86BR

DATE DRILLED 9/11-23/86 EQUIPMENT MOBILE B-57

DESCRIPTION BSA ELEVATION 6081 18

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
			21				
			22				
	100	5 0 / 5 0	23			Silty Claystone Light olive gray to olive gray (5Y 5/2 to 5Y 3/2) Some dark yellowish orange (10YR 6/6) iron staining Some black organic fragments Firm damp	
			24				
			25				
			26				
			27				
	100	5 0 / 5 0	28			Silty Claystone Medium dark gray (N4) Firm damp	
			29				
			30				
			31				
			32				
			33				
	100	5 0 / 5 0	34			Claystone Dusky yellow, (5Y 6/4) to light olive gray (5Y 5/2) to medium light gray (N5) Trace silt some organic fragments dark yellowish orange (10YR 6/6) mottling in light olive gray areas No apparent fractures moderately soft to firm damp	
			35				
			36				
			37				
			38				
	69	2 9 / 2 0	39			Claystone Medium light gray, (N5) Iron staining at 39 0 Subvertical fracture with iron staining from 39 0 to 39 8 Core has a mottled appearance with yellowish gray (5Y 8/1) stains throughout Firm to moderately soft damp	

DRILLING CONTRACTOR Boyle Brothers Drilling

DRILLER

BY LAA

DATE 9/23/86 CHKD BY

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 23-86BR

DATE DRILLED: 9/11-23/86 EQUIPMENT: MOBILE B-57

DESCRIPTION: ESA ELEVATION: 5081.18

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
			41			Claystone Olive gray, (5Y 4/1) Trace silt Some organic fragments Vertical limonite filled fracture from 40 9 to 42 5, horizontal limonite filled fracture at 41 9 Firm to moderately soft damp	
	66	5 0 / 2 6	42				
			43				
			44				
			45				
			46			Claystone Medium, (N5) to medium dark gray (N4) Highly fractured interval with limonite along fracture planes (2mm wide) from 48 3 to 49 6 Top 4 0 of core has abundant organics (wood fragments) Firm, damp	
	96	5 0 / 4 8	47				
			48				
			49				
			50			Claystone Dusky yellow, (5Y 6/4)	
			51			Claystone Light olive gray, (5Y 5/2) Heavy limonite along fracture planes Claystone Medium dark gray (N4) with interbedded dusky yellow (5Y 6/4) clayey siltstone	
	80	5 0 / 4 0	52				
			53			Silty Claystone Medium dark gray (N4) Occasional subvertical fracture with limonite stain (up to 0 7 long) Firm damp	
			54				
			55				
			56			Silty Claystone Olive gray (5Y 3/2) to medium gray, (N4) Trace iron staining at top of core Firm, damp	
	83	4 8 / 3 8	57				
			58				
			59				

DRILLING CONTRACTOR: Boyles Brothers Drilling Co. D. JARVIS

DRILLER

DATE: 5/26/87

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING. SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

LOG OF BORING No. 23-86BR

DATE DRILLED 9/11-23/86 EQUIPMENT MOBILE B-67

DESCRIPTION HSA ELEVATION 5081 18

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	TESTS
	100	4 6 / 4 6	61			
			62			
			63			
			64			
			65			
	100	5 0 / 5 0	66			
			67			
			68			
			69			
			70			
	50	5 0 / 2 5	71			
			72			
			73			
			74			
			75			
	96	5 0 / 4 8	76			
			77			
			78			
			79			

Siltstone Dark gray, (N3) grading downward into dark greenish gray, (5GY 4/1) clayey siltstone Some organic wood fragments Firm damp

Clayey Siltstone Dark greenish gray, (5GY 4/1) Trace very fine grained sand Dark gray (N3) clayey siltstone from 68 5 to 70 5 Calcareous layer at 66 5 with slight dark yellowish orange (10YR 6/6) iron stains Firm, damp

Silty Claystone Dark greenish gray, (5GY 4/1) Trace very fine grained sand Highly fractured Some organic fragments in vertical fractures Crumbly damp

Siltstone Dark greenish gray, (5GY 4/1) Some clay and very fine grained sand, few organics Very pale orange, (10YR 8/2) calcareous clay layer at 77 5 Firm, damp

DRILLING CONTRACTOR Hughes Brothers Drilling
DRILLER D JARVIE
BY IAA
DATE 6/26/87 CHKD BY

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 23-86BR

DATE DRILLED 9/11-23/86 EQUIPMENT MOBILE B-57

DESCRIPTION HSA ELEVATION 5981 18

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
	92	5 0 / 4 6	81			Siltstone Dark gray, (N3) to dark greenish gray, (5GY 4/1) Interbedded 0 1' to 0 3 beds of sandy siltstone Convoluted bedding in places Occasional clayey siltstone Firm damp	
			82				
			83				
			84				
			85				
	100	5 0 / 5 0	86			Siltstone Dark gray (N3) to dark greenish gray, (5GY 4/1) Interbedded sandy siltstone beds, (0 5 thick) Occasional clayey siltstone layers, organics throughout Calcareous concretions from 87 8 to 88 4 Firm, damp	
			87				
			88				
			89				
			90				
	100	5 0 / 5 0	91			Siltstone Dark gray, (N3) Interbedded sandy siltstone and clayey siltstone beds Sand is very fine grained Vertical fracture from 92 5 to 95 5 due to drilling Crumbly firm damp	
			92				
			93				
			94				
			95				
	96	5 0 / 4 8	96			Siltstone Dark gray, (N3) Trace very fine grained sand throughout, some organics Laminated light olive gray, (5Y 6/1) mottling around organic fragments Firm, damp	
			97				
			98				
			99				

DRILLING CONTRACTOR D JAVA

DRILLER

BY TAA

DATE 5/26/92

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 23-86BR

DATE DRILLED 9/11-23/86 EQUIPMENT MOBILE B-57

DESCRIPTION BSA ELEVATION 6081 18

DRILLING CONTRACTOR D JARVIS

DRILLER

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
	100	5 0 / 5.0	101			Sandy Siltstone Dark gray, (N3) Interbedded silty sandstone beds at 102 6' and 103 8, (approx 0 4 thick) Sandstone layers consist of medium gray (N5) very fine grained silty sand, moderately sorted, convoluted bedding characteristic of interbedded siltstone and sandstone layers Some calcareous concretions in sandy siltstone layers Abundandant organics Firm to hard damp	
			102				
			103				
			104				
			105				
	84	5 0 / 3 2	106			Clayey Siltstone Dark gray, (N3) Soft to firm, damp	
			107				
			108				
			109				
			110				
	92	5 0 / 4.6	111			Clayey Siltstone Dark gray, (N3) Increasing sand through interval	
			112				
			113				
			114			Sandstone Medium gray, (N5) Fine to very fine grained Occasional clay filled vertical fracture Moderately sorted Firm, damp	
			115				
	100	5 0 / 5 0	116			Sandstone Medium gray, (N5) Fine to very fine grained, moderately sorted Firm damp Gradational change to siltstone at 116 5	
			117			Sandy Siltstone Dark gray, (N3) Very fine grained, well sorted Some clay, organic fragments in subvertical fractures and horiztonal layers Subvertical fractures have slickensides Fractures are 1 0 to 1 5 apart	
			118				
			119				

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 23-86BR

DATE DRILLED 9/11-23/86 EQUIPMENT MOBILE B-67

DESCRIPTION EBA ELEVATION 6081 18

DRILLING CONTRACTOR D JARVIE

DRILLER

BY LAA

DATE 5/26/87

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
			120				
	100	60 / 60	121			Clayey Siltstone Dark gray, (N3) to medium gray, (N5) Interbedded sandy siltstone Sand is fine to very fine grained, moderately sorted Some organic fragments Slickinsides along fracture planes	
			122				
			123				
			124				
			125				
	96	50 / 48	126			Clayey Siltstone Dark gray (N3) to medium gray (N5) Occasional interbedded sandy siltstone Occasional light brown, (5YR 6/4) calcareous concretions Moderately sorted Firm damp	
			127				
			128				
			129				
			130				
			131			Total Borehole Depth 130 5 ft	
			132				
			133				
			134				
			135				
			136				
			137				
			138				
			139				

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 25-86

Page 1 of 5

DATE DRILLED 8/26/86 EQUIPMENT MOBILE B-57

DESCRIPTION HSA ELEVATION 5974.45

DRILLING CONTRACTOR Boyles Brothers Drilling Co

DRILLER D. JARVIE

BY MGW DATE 7/10/89 CHKD BY

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
			1			Sandy, Silty Gravel Light brown, (5yr 6/4), granite and quartzite, angular to subangular cobbles and pebbles Poorly sorted, dry	
			2				
			3				
			4				
			5			Clayey Sand Very pale orange (10yr 8/2), to grayish orange, (10yr 7/4) Very fine grained Some granite and quartzite pebbles and cobbles Medium plasticity Grades to very clayey, dark yellow orange, (10yr 6/6) sand with large cobbles at base of sample Poorly sorted, subangular to angular Low to medium plasticity, damp	
			6				
			7				
			8				
			9				
			10			Claystone Light olive brown, (5yr 5/6), some silt, trace sand Sand layers from 10 4 - 10 7' and 11 4 - 11 6' Sand is very pale orange, (10yr 8/2), coarse grained, moderately sorted, subangular trace calcareous cement Unconsolidated, soft, wet Clay is firm, moist	
			11				
			12				
			13			Claystone Medium dark gray, (N4) with grayish orange (10yr 7/4) and pale olive (10yr 6/2) mottling Some silt with very coarse grained sand lenses less than 0 2' thick Ironstone layer at 12 9 - 13 2' with calcareous cement Firm, moist	
			14				
			15				
			16				
			17				
			18			Claystone Yellow brown (10yr 5/4), Damp	
			19				
			20			As Above - Gray brown (5yr 3/2), moist	

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

25-86

ROCKY FLATS PLANT

PAD 904 CLOSURE

PROJECT NO xxx-xx

LOG OF BORING No. 25-86

DATE DRILLED 8/26/86 EQUIPMENT MOBILE B-57

DESCRIPTION HSA ELEVATION 5974.45

DRILLING CONTRACTOR Boyles Brothers Drilling Co

DRILLER D. JARVIE

BY MGW DATE 7/10/89 CHK'D BY

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
			20			Claystone Light gray-brown (5yr 6/1), damp	
			21				
			22			As Above - Silty, very wet (cored with water)	
			23				
			24				
			25				
			26				
			27				
			28				
			29				
			30				
			31				
			32				
			33				
			34				
			35				
			36				
	0	4 6 / 0	37			No Recovery	
			38				
			39				
			40				

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

25-86

LOG OF BORING No. 25-86

Page 3 of 5

DATE DRILLED 8/26/86 EQUIPMENT MOBILE B-57

DESCRIPTION HSA ELEVATION. 5974.45

DRILLING CONTRACTOR Boyles Brothers Drilling Co

DRILLER D. JARVIE

BY MGW DATE 7/10/89 CHK'D BY

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	TEST DRIVEN / TEST SAMPLE	DEPTH IN FEET	WELL OR PIEZO-METER CON-STRUCTION	GRAPHIC LOG		TESTS
			40			No Recovery	
			41				
	100	50 / 50	42			Claystone Light olive-gray (5yr 5/2), to olive-gray (5yr 3/2), with light brown to dark yellow orange (10yr 6/6), iron staining, trace silt, damp	
			43				
			44				
			45				
			46			As Above - Altered claystone concretions	
	100	50 / 50	47			Claystone Light brown (10yr 6/6), grading to medium dark gray (N4), high angle fractures with calcite along fracture planes, moist	
			48				
			49			As Above - Heavy iron staining	
			50				
			51				
	100	50 / 50	52			Claystone Gray black (N2) to dark gray (N3), with occasional dark yellow orange (10yr 6/6), iron staining some coaly layers and fragements damp	
			53				
			54				
			55				
			56				
			57			As Above - gray black (N2), silty, Some wood fragements, damp	
			58				
			59				
			60				

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

25-86

LOG OF BORING No. 25-86

Page 4 of 5

DATE DRILLED 8/26/86 EQUIPMENT MOBILE B-57

DESCRIPTION HSA ELEVATION. 5974.45

DRILLING CONTRACTOR Boyles Brothers Drilling Co

DRILLER D. JARVIE

BY MGW DATE 7/10/89 CHK'D BY

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	DESCRIPTION	TESTS
			60				
			61				
	80	50 / 40	62			Claystone Light olive gray (5yr 5/2), Silty, dry to damp	
			63			Calcareous	
			64			Occasional very fine-grained sandstone laminations	
			65				
			66				
	100	50 / 50	67			Claystone Gray-black (N3), Thin interbedded silty claystone and clayey siltstone, highly fractured with numerous subvertical slickensides, Crumbly to firm, damp	
			68				
			69				
			70			▽ 9/86	
			71				
	0	24 / 0	72			No Recovery	
			73				
	100	50 / 50	74			Sandstone Dark green-gray (5yr 4/1), Very fine-grained silty, some clay, laminations of siltstone, convoluted bedding, Moderately sorted, sorted, firm, damp	
			75				
			76				
			77				
			78				
	100	21 / 21	79				
			80				

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 25-86

DATE DRILLED 8/26/86 EQUIPMENT: MOBILE B-57

DESCRIPTION HSA ELEVATION: 5974.65

DRILLING CONTRACTOR Boyles Brothers Drilling Co

DRILLER D JARVIE

BY MGW DATE 7/10/89 CHK'D BY

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
			80				
			81				
	87	15 / 13				As Above - some coal lenses, firm, damp	
			82				
	94	32 / 30	83				
						Siltstone Gray-black (N3), with alternating laminations of very fine-grained and sandy siltstone and clayey siltstone, thin very fine-grained coal lenses, some convoluted bedding, firm, dry to damp	
			84				
			85				
	57	42 / 24	86	HOLE CAVED			
			87				
			88				
			89				
			90			Total Borehole Depth 89 8 Ft	
			91				
			92				
			93				
			94				
			95				
			96				
			97				
			98				
			99				
			100				

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

25-86

LOG OF BORING No. 5-87BR

Page 1 of 4

DATE DRILLED 8/22/87 EQUIPMENT MOBILE B-67

DESCRIPTION RBA ELEVATION 6027 76

Boyles Brothers Drilling Co

DRILLING CONRACTOR T MERRITT

DRILLER

BY LAA

DATE 6/21/89 CHK'D BY

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLE	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	
	80	2.0 / 1.2	1			Sandy Clay Moderate brown, (10YR 4/4) Abundant organics Moist (Topsoil) TOPSOIL/SOIL
	100	2.0 / 2.0	2			Clay Dark yellowish brown, (10YR 4/2) Trace sand, some quartzite pebbles Weathered, moist
			3			
	100	4.0 / 4.0	4			Silty Clay Moderate yellowish brown, (10YR 5/4 Moist
			5			
			6			Silty Clay Moderate yellowish brown, (10YR 5/4) Abundant quartzite pebbles, trace sand Moist
			7			
	60	5.0 / 3.0	8			
			9			
			10			Gravelly Sand Light brown, (5YR 5/6) Moist
			11			
			12			SOIL/BEDROCK
	100	5.0 / 5.0	13			Claystone Olive gray (5Y 3/2) Abundant limonite stains Fractured moist
			14			
			15			
			16			
			17			
	100	5.0 / 5.0	18			
			19			

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 5-87BR

Page 2 of 4

DATE DRILLED 8/22/87 EQUIPMENT MOBILE B-57

DESCRIPTION BSA ELEVATION 6027 76

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZO-METER CON-STRUCTION	GRAPHIC LOG		TESTS
			21				
			22				
			23				
	20	4.0 / 0.8	24			Claystone Light olive (10Y 5/4) with some light olive brown (5Y 5/6) mottles Some very fine grained sand at 23 5 Dense, weathered moist	
			25				
			26				
			27				
	65	2.0 / 1.3	28			Claystone Light olive brown (10YR 5/4) with common moderate reddish orange, (10Y 6/6) mottles Some fractures, weathered, moist	
			29				
	5	4.0 / 0.2	30				
			31				
			32				
			33				
	192	1.3 / 2.5	34			Claystone Moderate olive brown, (5Y 4/4) Abundant moderate reddish brown, (10R 4/6) mottles Abundant FeO2 concretions, weathered, dense, dry	
	0	4.2 / 0	35			No recovery	
			36				
			37				
			38				
	100	1.7 / 1.7	39			Claystone Moderate olive brown, (5Y 4/4) with abundant light olive brown (5Y 5/6) mottles Homogenous damp	

DRILLING CONTRACTOR Boyles Brothers Drilling Co.

DRILLER J. MERRITT

BY LAA

DATE 8/27/87 CHKD BY

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 5-87BR

DATE DRILLED 5/22/87 EQUIPMENT MOBILE B-57

DESCRIPTION HSA ELEVATION 5027 76

DRILLING CONTRACTOR Boyles Brothers Drilling Co

DRILLER T MERRITT

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	
	0	13 / 0	41			No recovery
	100	30 / 30	42			Claystone Dusky yellow (5Y 6/4) Abundant FeO stains, moderate brown, (5YR 4/4) Some very fine grained sand sorted Large fracture from 42 3-43 3 (vertical) Slightly damp
			43			
			44			
	108	35 / 38	45			Claystone Dusky yellow, (5Y 6/4) with abundant moderate brown (5YR 4/4) stains Two 45 degree fractures at 44 7 and 45 5 Damp
			46			Clayey Sandstone Moderate yellowish brown, (10YR 5/4) Very fine grained, well sorted Approximately 20% clay Abundant moderate brown (5YR 4/4) stains Damp
			47			
	100	48 / 46	48			
			49			
			50			
			51			
			52			Claystone Olive gray (5Y 3/2) Dense homogenous unweathered damp
	107	45 / 48	53			Claystone Olive gray (5Y 3/2) Abundant light brown (5Y 5/6) stains Consolidated homogenous, fractured moist
			54			
			55			
			56			
	103	40 / 41	57			
			58			
			59			

BY [illegible] DATE 6/22/89 CHKD BY [illegible]

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 5-87BR

DATE DRILLED 8/22/87 EQUIPMENT MOBILE B-57

DESCRIPTION HSA ELEVATION 6027 76

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
						Claystone Same as above	
			61			Total Depth of Borehole 61 0 ft	
			62				
			63				
			64				
			65				
			66				
			67				
			68				
			69				
			70				
			71				
			72				
			73				
			74				
			75				
			76				
			77				
			78				
			79				

DRILLING CONTRACTOR Boyle Brothers Drilling Co

DRILLER T MERRITT

BY IAA

DATE 8/22/89 CHKD BY

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 9-87BR

Page 1 of 2

DATE DRILLED 6/12/87 EQUIPMENT MOBILE B-67

DESCRIPTION 7 5 INCH HSA ELEVATION 5000.22

DRILLING CONTRACTOR Boyles Brothers Drilling Co

DRILLER P SHARP

BY LAA

DATE 6/15/89 CHKD BY

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	
	70	1 5 / 1 4 5	1			Sandy, Clayey Gravel Grayish brown, (5YR 3/2) Abundant roots and grasses Unconsolidated, dry
	110	1 5 / 1 5 5	2			Clayey Gravel Pale yellowish brown, (10YR 6/2) Gravels to cobbles, angular, pink and gray quartzite and granite Unconsolidated, dry
	83	1 2 / 1 0	3			Clayey Gravel Moderate yellowish brown, (10YR 5/4) matrix Pink and gray quartzite and granite Trace sand Unconsolidated unsorted dry
	188	0 8 / 1 5	4 5			No recovery
	40	1 5 / 0 8	6 7			Silt Pale yellowish brown, (10YR 6/2) Some quartzite cobbles Dry (Sample distorted by cuttings from center bit)
	100	2 0 / 2 0	8 9			Clayey Gravelly Sand Moderate yellowish brown (10YR 5/4) Medium grained sand Abundant quartzite and granite, angular to subrounded Unconsolidated, dry
	67	3 0 / 2 0	10 11			Clayey Sand Moderate yellowish brown, (10YR 5/4) Medium to coarse grained Clay amount approximately 40% Dry
			12			Core not located
	80	2 5 / 2 0	13			TOPSOIL/SOIL Sandstone Light brown (5YR 6/4) Very fine grained rounded well sorted Trace silt Wet Some peices of clay present
			14			Sandstone Pale yellowish brown (10Y 6/2) Quartzose coarse grained, well sorted rounded Moist
	72	2 5 / 1 8	15 16			Sandstone Yellowish gray, (5Y 8/1) Fine to medium grained well sorted Some bits of clay and very fine gravel Friable, moist
	80	2 5 / 2 0	17 18			▽ Same as above Wet Clay Olive gray, (5Y 3/2) Wet
			19			Same as above Sandstone

TESTS

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

9-1784

ROCKY FLATS PLANT

PAD 904 CLOSURE

PROJECT NO 887-10

LOG OF BORING No. 9-87BR

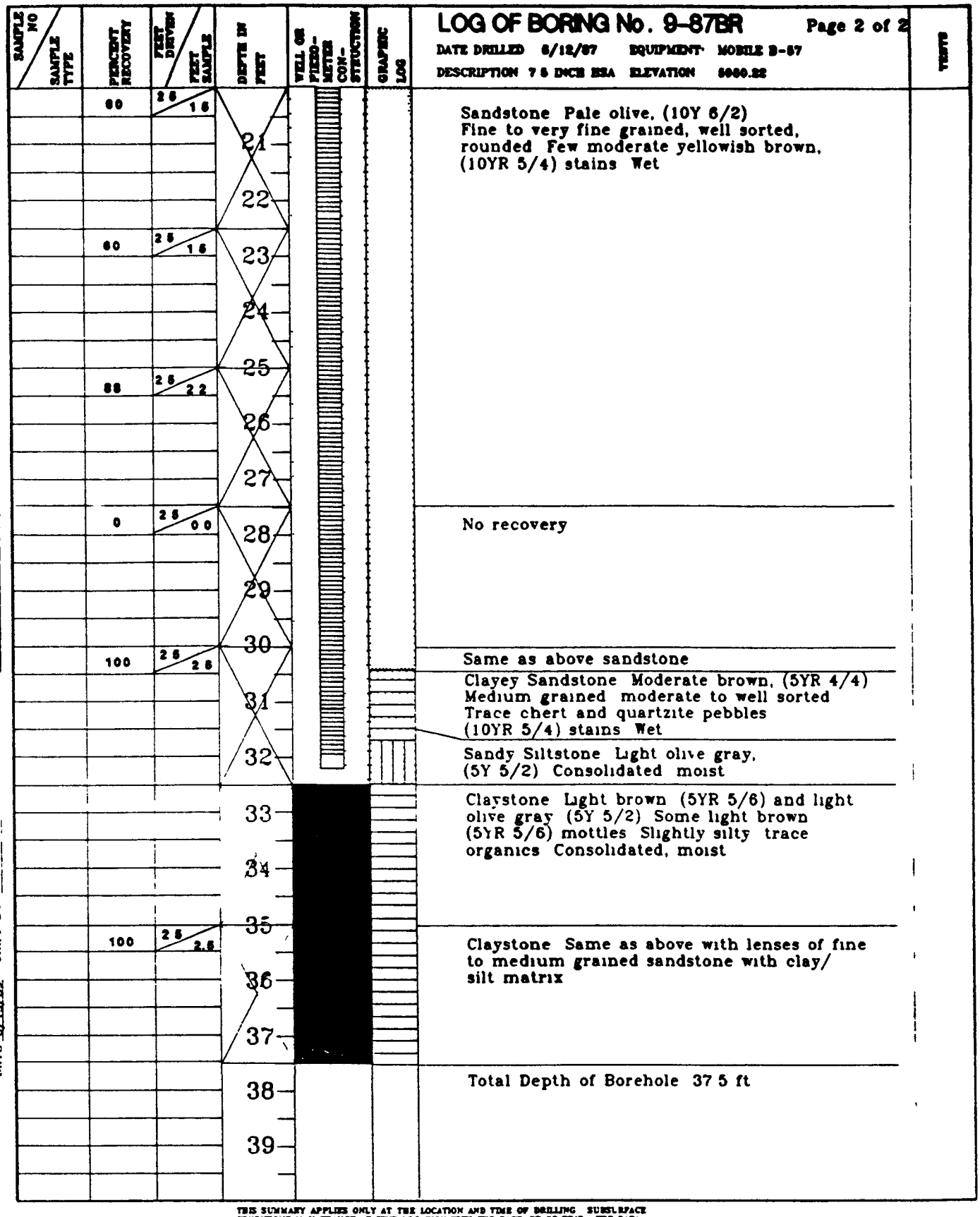
DATE DRILLED 6/12/87 EQUIPMENT MOBILE B-57

DESCRIPTION 7 8 INCH HSA ELEVATION 6060.22

DRILLING CONTRACTOR Boyles Brothers Drilling Co

DRILLER R SHARP

BY LAA DATE 6/15/89 CHK'D BY



Sandstone Pale olive, (10Y 6/2) Fine to very fine grained, well sorted, rounded Few moderate yellowish brown, (10YR 5/4) stains Wet

No recovery

Same as above sandstone

Clayey Sandstone Moderate brown, (5YR 4/4) Medium grained moderate to well sorted Trace chert and quartzite pebbles (10YR 5/4) stains Wet

Sandy Siltstone Light olive gray, (5Y 5/2) Consolidated moist

Claystone Light brown (5YR 5/6) and light olive gray (5Y 5/2) Some light brown (5YR 5/6) mottles Slightly silty trace organics Consolidated, moist

Claystone Same as above with lenses of fine to medium grained sandstone with clay/ silt matrix

Total Depth of Borehole 37 5 ft

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 16-87BR

Page 1 of 9

DATE DRILLED 9/17/87 EQUIPMENT MOBILE B-57

DESCRIPTION BSA ELEVATION 5069 06

DRILLING CONTRACTOR Boyles Bros Drilling Co

DRILLER D JARVIS

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
	100	20 / 20	1			Sandy Gravel Pale yellowish brown, (10YR 6/2) Quartzite pebbles and cobbles, subrounded to subangular Some silt and clay Some rock in upper 0 5 Dry	
	82	20 / 16 4	2 3 4			Sandy Gravel Moderate brown, (5YR 4/4) Quartzite pebbles and cobbles subrounded to subangular Some silt and clay Dry	
	47	20 / 9 5	5 6			Sandy Gravel Moderate brown, (5YR 4/4) Grades into caliche Dry	
	145	10 / 14 5	7			Sand and Clay Yellowish gray, (5Y 7/2) to moderate brown, (5Y 4/4) Coarse sand Some quartzite cobbles, caliche Damp	
	45	20 / 0 9	8 9			Sandy Gravel Light brown (5YR 6/4) Quartzite pebbles and cobbles subrounded to subangular Dry	
	87	20 / 1.75	10 11			Sandy Gravel to Sandy Clay Gravel moderate brown (5YR 4/4) sand light brown, (5YR 5/6) to dark greenish gray (5GY 4/1) Iron stained streaks moderate reddish orange, (10R 6/6) Trace caliche Weathered dry	
	100	20 / 2.0	12 13			Sand Moderate reddish orange, (10R 6/6) Coarse Some quartzite pebbles trace caliche Weathered damp	
	100	20 / 2.0	14 15			Sandy Gravel Dark yellowish orange, (10YR 6/6) to grayish green, (10GY 5/2) Quartzite pebbles and cobbles Damp to dry	
	100	20 / 2.0	16 17			Sandy Gravel Moderate reddish orange, (10R 6/6) Numerous quartzite pebbles trace caliche Highly weathered damp	
	85	20 / 1.7	18 19			Sand Moderate reddish orange, (10R 6/6) Numerous quartzite pebbles Weathered damp	
	85	20 / 17				Sandy Gravel Moderate brown, (5YR 4/4) Quartzite pebbles and cobbles Wet	

HOLE NO 16-87BR

DATE 6/15/89 CHKD BY

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 16-87BR

Page 2 of 9

DATE DRILLED 6/7/87-7/8/87 EQUIPMENT MOBILE B-67

DESCRIPTION BSA ELEVATION 5069.06

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
			21			Sandy Gravel Moderate brown, (5YR 4/4) Quartzite pebbles and cobbles Some silt present Wet	
	80	20 / 10	22			TOPSOIL/SOIL	
						Clay Olive gray (5Y 3/2) Dry	
	90	10 / 09	23			Clay Medium light gray (N 6/0) Iron staining moderate reddish orange, (10R 6/6) Wet	
	100	20 / 20	24			Clay Medium light gray, (N 6/0) to olive gray, (5Y 3/2) Iron staining moderate reddish orange (10R 6/6) to dark reddish brown, (10R 4/6) Highly weathered Damp to wet	
	100	20 / 20	25				
			26			Clay Olive gray (5Y 3/2) Iron staining moderate reddish orange, (10R 6/6) Slightly weathered, damp	
			27				
	140	10 / 14	28			Clay Olive gray, (5Y 3/2) Iron staining moderate reddish orange, (10R 6/6) Weathered damp	
	138	10 / 136	29			Clay Moderate olive brown, (5Y 4/4) to olive gray, (5Y 3/2) Some iron staining moderate reddish orange, (10R 6/6) Damp	
	100	20 / 20	30			Clay Moderate reddish orange (10R 6/6) to dark reddish brown (10R 3/4) Upper foot olive gray, (5Y 3/2) Iron Staining moderate reddish orange (10R 6/6) throughout Some dusky yellow areas (5Y 6/4) Highly weathered wet	
			31				
	100	20 / 20	32			Clay Olive gray (5Y 3/2) Iron staining moderate reddish orange (10R 6/6) Weathered wet	
			33				
	100	20 / 20	34				
			35				
	100	20 / 20	36				
			37				
	100	20 / 20	38			Clay Light olive gray, (5Y 5/2) Iron staining moderate reddish orange, (10R 6/6) Weathered wet	
			39				

Fuller Brothers Drilling Co.

DRILLING CONTRACTOR D. JARVIS

DRILLER

BY LAA

DATE 5/15/89 CHKD BY

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 16-87BR

Page 3 of 9

DATE DRILLED 6/7/87- 7/8/87 EQUIPMENT MOBILE B-57

DESCRIPTION RSA ELEVATION 5969 06

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
	100	2 0 / 2 0	41			Clay Light olive gray, (5Y 5/2), with some olive gray, (5Y 3/2) streaks Some iron staining, moderate reddish orange, (10R 6/6) Weathered, wet	
	105	2 0 / 2 1	42				
			43				
			44			SOIL/BEDROCK	
	100	2 0 / 2 0	45			Claystone Brownish black (5YR 2/1) Unweathered	
			46				
	100	2 0 / 2 0	47				
			48				
	100	2 0 / 2 0	49			Cement	
	63	3 5 / 2.2	50			Claystone Olive gray (5Y 3/2) Trace moderate yellowish brown (10YR 5/4) mottles Homogenous consolidated wet	
			51				
	100	4 0 / 4 0	52			Claystone Grayish black (N 2/0) Abundant lignite stringers from 50 5-51 5 Organic rich Some very fine grained sand Dense, consolidated dry	
			53				
			54				
			55				
	100	4 5 / 4 5	56			Claystone Olive gray, (5Y 3/2) Trace sand bottom 0 5 Dense homogenous, moist	
			57				
			58				
			59				

DRILLING CONTRACTOR D JARVIS

DRILLER

LAA

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 16-87BR

Page 4 of 9

DATE DRILLED: 7/6/87 - 7/7/87 EQUIPMENT: MOBILE B-57

DESCRIPTION: ESA ELEVATION: 6069.06

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
	32	6.0 / 1.6	61			Claystone Olive gray, (5Y 3/2) Some very fine grained silty sand Trace organics Dense, homogenous, moist.	
			62				
			63				
			64				
	98	3.0 / 2.8	65			Sandy Claystone Olive gray, (5Y 3/2) Trace organic fragments Sandstone layer at 66 1 - 67 1 Very fine grained silty, moist to dry	
			66				
			67				
	75	4.0 / 3.0	68			Claystone Olive gray, (5Y 3/2) Abundant organics, consolidated moist	
			69				
			70				
			71				
	113	4.0 / 4.5	72			Claystone Olive gray (5Y 3/2) Abundant organics dense moist Last 1 0 grade to dusky green (5G 3/2) claystone with no organics Silty moist to dry	
			73				
			74				
			75				
	80	4.0 / 3.2	76			Claystone Olive gray (5Y 3/2) Silty, organic rich, dense, moist	
			77			Sandstone/Claystone Olive gray, (5Y 3/2) and light olive gray (5Y 5/2) Interbedded medium grained sandstone, rounded, sorted moist	
			78			Sandstone Olive gray, (5Y 3/2) Well sorted rounded, medium to fine grained Salt and pepper texture, abundant organics, moist	
			79			Sandstone Same as above but more clay Damp to dry	

DRILLING CONTRACTOR: Boyles Brothers Drilling Co

DRILLER: D. ARMI

DATE: 5/15/87

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING. SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

LOG OF BORING No. 16-87BR

Page 5 of 9

DATE DRILLED 9/7/87 EQUIPMENT MOBILE B-57

DESCRIPTION EIA ELEVATION 6069.06

DRILLING CONTRACTOR ... DRILLER D MARVIL

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLE	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
	100	4.0 / 4.0	81			Claystone Olive gray, (5Y 3/2) Organic rich Consolidated, homogenous, damp	
			82				
			83				
			84				
	100	4.0 / 4.0	85			Claystone Same as above with some lignite stringers and trace sand Moist	
			86				
			87				
			88			Silty Sandstone Olive gray, (5Y 3/2) Very fine grained Common organics Moist	
	100	4.0 / 4.0	89			Claystone Olive gray (5Y 3/2) Trace organics Sandy top 3 Consolidated, homogenous, moist	
			90				
			91				
			92				
	100	4.5 / 4.5	93			Claystone Olive gray (5Y 3/2) Trace organics Moderate yellowish brown (10YR 5/4) siltstone nodule at 94.0-94.5 Less than 1 wide Consolidated homogenous trace organics Moist	
			94				
			95				
			96				
	83	4.0 / 3.3	97			Claystone Olive gray, (5Y 3/2) Two siltstone nodules, moderate yellowish brown, (10YR 5/4) approximately 1/4 diameter, elliptical Dry to moist	
			98			Sandy Claystone Olive gray, (5Y 3/2) Very fine grained sand, well sorted silty Moist	
			99				

LOGGED BY CHKD BY DATE 6/16/89

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 16-87BR

Page 6 of 9

DATE DRILLED: 6/7/87-7/8/87 EQUIPMENT: MOBILE B-57

DESCRIPTION: EBA ELEVATION: 6068.06

DRILLING CONTRACTOR: Hoyles Brothers Drilling Co

DRILLER: D. JARVIE

LOGGED BY: LAA

DATE: 6/16/89 CHECKED BY:

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
	88	4.8 / 4.0	101			Sandstone Medium gray, (N 5/0) Silica cement Fine to medium grained, sorted, rounded Two light brownish gray, (5YR 6/1) siltstone nodules at 102 9' and 104 2 Clayey on top 6 Salt and pepper look, moist	
			102				
			103				
			104				
	108	4.0 / 4.3	105			Sandstone Same as above with several clay stringers Very dense Rock hard sandstone at 108 1 to 109 Very fine grained Calcareous cement, reacts strongly with HCl Moist to dry	
			106				
			107				
			108				
	83	4.0 / 3.3	109			Sandstone Medium gray, (N 5/0) Rock hard very dense, very fine grained calcareous cement, damp	
			110			Clayey Sandstone Medium gray (N 5/0) Very fine grained, rounded, well sorted Increased clay with depth Moist to damp	
			111				
			112				
			113			No sample taken as indicated on original log	
			114				
			115				
			116				
	125	4.0 / 5.0	117			Clayey Sandstone and Sandy Claystone Same as above with more clay Dense moist	
			118			Sandy Claystone Medium gray, (N 5/0) Fine grained sand rounded well sorted Siltstone nodule, light brownish gray, (5YR 6/1) at 120 7 Moist	
			119				

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

-1 EPG

LOG OF BORING No. 16-87BR

Page 7 of 9

DATE DRILLED 7/6/87 - 7/7/87 EQUIPMENT MOBILE B-57

DESCRIPTION RSA ELEVATION 5960 06

DRILLING CONTRACTOR Bryte Brothers Drilling Co

DRILLER D HARVIE

LOGGED BY LAA

DATE 6/16/88 CHKD BY

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
			121				
	93	4.0 / 3.7	122			Interbedded Sandstone/Claystone Medium gray, (N 5/0) Very fine grained, silty, clayey sandstone Interbedded clay laminations Sandstone is rounded, dense sorted 10 degree dip on fracture cross-bedded moist	
			123				
			124				
			125				
	95	4.0 / 3.8	126			Interbedded Sandstone/Claystone Same as above Sandstone beds 1-2 thick Some light brownish gray, (5)R 6/1) siltstone nodules 1 diameter Damp	
			127				
			128				
			129				
	75	4.0 / 3.0	130			Interbedded Sandstone/Claystone Same as above with clay layers 0 8 to 1 0 thick	
			13.				
			132				
			133				
	125	4.0 / 5.0	134			Sandstone/Sandy Claystone Medium gray (N 5/0) Very fine grained well sorted rounded, dense Horizontal fractures Moist to wet	
			135				
			136				
			137				
	100	4.0 / 4.0	138			Sandstone/Sandy Claystone Same as above with medium to fine grained sand Damp	
			139				

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

-8 867

ROCKY FLATS PLANT

PAD 904 CLOSURE

PROJECT NO 867-10

LOG OF BORING No. 16-87BR

DATE DRILLED: 8/7/87-8/8/87 EQUIPMENT: MOBILE B-57

DESCRIPTION: ESA ELEVATION: 5969.06

DRILLING CONTRACTOR: Eyles Brothers (Drilling) Ltd.

DRILLER: D. JARVIS

LOGGED BY: [illegible]

DATE: 6/16/89

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	DESCRIPTION	TESTS
			141				
	88	40 / 39	142			Sandstone Medium gray, (N 5/0) Fine to medium grained sand well sorted, rounded silica cement Organic fragment in shoe Damp	
			143				
			144				
			145				
	80	40 / 32	146			Interbedded Sandstone/Claystone Medium gray (N 5/0) Clay layers 1 sand layers 3-6 Silty, clayey sandstone Dense, consolidated moist to wet	
			147				
			148				
			149				
	123	40 / 4.9				Clayey Sandstone Medium gray, (N 5/0) Very fine grained silty rounded damp	
			150			Claystone Olive gray (5Y 3/2) No sand, some organic fragments Consolidated, moist	
			151				
			152				
			153				
	100	40 / 40				Interbedded Sandstone/Claystone Medium gray (N 5/0) Few organics Very fine grained sand rounded cross bedded wet Claystone layers 1 sandstone layers 1 Dense homogenous moist	
			154				
			155				
			156				
			157				
	93	40 / 3.7				Sandstone Medium gray (N 5/0) Some clay lenses 1/4 to 4 wide Cross bedded fine to medium grained well sorted, rounded Salt and pepper texture Very dense calcareous cemented sandstone at 157.3-157.6 Moist to wet	
			158				
			159				

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING. SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

LOG OF BORING No. 16-87BR

Page 9 of 9

DATE DRILLED 9/7/87- 7/8/87 EQUIPMENT MOBILE B-67

DESCRIPTION RBA ELEVATION 5969 06

DRILLING CONTRACTOR O JARVIE

DRILLER

BY LAA

DATE 6/16/89 (HK D H)

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	DESCRIPTION	TESTS
			161				
	73	40 / 28				Sandstone Medium light gray, (N 6/0) Very fine grained, calcareous cement, strongly reacts with HCl Very dense, damp to dry	
			162				
						Silty Sandstone Medium gray (N 5/0) Very fine rounded well sorted grains Cross bedded with few clay laminae Moist to wet	
			163				
						Claystone Olive gray (5Y 3/2) Trace sand trace organics Dense homogenous moist to wet	
			164				
			165				
	111	45 / 50				Claystone Olive gray, (5Y 3/2) Trace Organics no sand Consolidated homogenous, wet	
			166				
			167				
			168				
			169				
	102	50 / 51	170				
			171				
			172				
			173				
			174			Total Depth of Borehole 174 0 ft	
			175				
			176				
			177				
			178				
			179				

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 45-87BR

Page 1 of 6

DATE DRILLED: 10/5-16/87 EQUIPMENT: MOBILE B-57

DESCRIPTION: EST ELEVATION: 6049.42

DRILLING CONTRACTOR: Boyles Brothers Drilling Co

DRILLER:

BY: LAA DATE: 6/21/89 CHKD BY:

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	TEST DRIVEN / TEST SAMPLE	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
	46	20 / 09	1			Clayey Sand and Gravel, (Topsoil) Moderate brown, (5YR 3/4) Poorly sorted with large subangular to subrounded quartzite cobbles No caliche, no HCl reaction Unconsolidated, dry	
			2			TOPSOIL/SOIL	
	78	20 / 16	3			Clayey Sand Pale yellowish brown, (10YR 6/2) Some subangular quartzite pebbles Unconsolidated damp	
			4			Sandy Clay Pale yellowish brown (10YR 6/2) to moderate yellowish brown (10YR 5/4) with dusky yellowish brown, (10YR 2/2) clay at very bottom Slight caliche, strong HCl reaction Unconsolidated, damp	
	107	30 / 32	5			Claystone Olive gray (5Y 4/1) Homogenous clay minor oxidation No caliche, no HCl reaction Consolidated, slightly damp	
			6				
			7				
	112	28 / 28	8				
			9				
	104	25 / 26	10				
			11			Clayey Siltstone Light olive gray, (5Y 6/1) with dark yellowish orange, (10YR 6/6) oxidation Very slight HCl reaction Moderately consolidated slightly damp	
	108	25 / 27	12			Claystone Heavily oxidized dark yellowish orange (10YR 6/6) and olive gray (5Y 4/1) Iron growth and leaf impressions Slight HCl reaction Dense consolidated damp	
			13				
			14			Clayey Siltstone Light olive gray, (5Y 6/1) and dark yellowish orange (10YR 6/6) Faintly laminated Oxidized moderately consolidated slightly damp	
	132	25 / 33	15			Claystone Light olive gray (5Y 6/1) and dark yellowish orange, (10YR 6/6) Heavily oxidized Very heavy staining around plant fragments Consolidated, damp	
			16				
	126	25 / 32	17				
			18				
			19				
	116	25 / 29				See next page for description	

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING. SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

LOG OF BORING No. 45-87BR

DATE DRILLED: 10/8-15/87 EQUIPMENT: MOBILE B-57

DESCRIPTION BST ELEVATION: 5048 42

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
			21			Claystone Light olive gray, (5Y 6/1) Oxidized clay becoming progressively less stained to brownish gray, (5YR 4/1) with lesser oxidation Consolidated, damp	
	90	10 / 08	22			Claystone Dark gray, (N 3/0) to brownish gray (5YR 4/1) Containing a thick (0 2) coal seam at 24 5 and small coal fragments throughout Dense consolidated damp	
			23				
			24				
	138	25 / 34	25			Claystone Dark gray, (N 3/0) to brownish gray (5YR 4/1) Oxidized plant fragments present Coal fragments becoming more oxidized down-core to light olive gray (5Y 6/1) and dark yellowish orange (10YR 6/6) Dense, consolidated, damp	
			26				
	120	25 / 30	27			Claystone Light olive gray (5Y 6/1) Mottled becoming less oxidized down-core to medium gray, (N 5/0) Contains small coal fragments Consolidated, damp	
			28				
			29				
	140	25 / 35	30			Claystone Medium gray, (N 5/0) to medium dark gray (N 4/0) Minor oxidation Consolidated damp	
			31				
	124	25 / 31	32			Silty Claystone Medium light gray (N 6/0) to yellowish gray (5Y 8/1) Becoming more oxidized down-core Contains dark yellowish orange (10YR 6/6) mottling Consolidated damp	
			33				
			34				
	92	25 / 23	35			Clayey Siltstone Medium gray (N 5/0) Consolidated damp	
						Clayey Siltstone Grayish orange, (10YR 7/4) to dark yellowish orange, (10YR 6/6) Heavily oxidized Consolidated, damp	
			36			Silty Claystone Olive gray (5Y 4/1) Oxidized, damp	
						Claystone Moderate brown, (5YR 4/4) to dark yellowish orange, (10YR 6/6) Extremely oxidized Very sharp upper contact Contains very dense concentric iron nodules with a very dark surgary texture Unconsolidated damp	
	90	25 / 22	37				
			38			Claystone Same as above Containing two large carbonate pebbles that react with HCl	
			39			Clayey Siltstone Grayish orange, (10YR 7/4) to dark yellowish orange (10YR 6/6) Oxidized Sharp upper contact with the clay Consolidated	
	100	25 / 25				Silty Claystone Medium gray (N 5/0) Mottled, oxidized, unconsolidated, damp.	

DRILLING CONTRACTOR

DRILLER

BY LAA

DATE 6/21/89 CHKD BY

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 45-87BR

DATE DRILLED: 10/6-15/87 EQUIPMENT: MOBILE B-57

DESCRIPTION BST ELEVATION 5949.42

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLE	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		REMARKS
			41			Silty Claystone Pale yellowish brown, (10YR 6/2) to grayish orange, (10YR 7/4) Dense, oxidized, well consolidated, damp	
	120	25 / 30	42			Silty Claystone Oxidized grayish orange, (10YR 7/4) to pale yellowish brown (10YR 6/2) Consolidated damp	
			43				
			44			Silty Claystone Light olive gray (5Y 6/1) Very dense, less oxidation, very well consolidated	
	110	25 / 27.5	45			Silty Claystone Grayish orange, (10YR 7/4) to pale yellowish brown, (10YR 6/2) Very dense, oxidized very well consolidated, damp	
			46				
	80	25 / 20	47				
			48			Clayey Siltstone Grayish orange, (10YR 7/4) to pale yellowish brown, (10YR 6/2), oxidized unconsolidated, dry to damp	
			49				
	110	25 / 27.5	50			Silty Claystone Medium gray, (N 5/0) Very dense minor oxidation	
			51				
	88	25 / 17	52			Claystone and Siltstone Laminated medium dark gray, (N 4/0) Unoxidized silty clay to grayish orange (10YR 7/4) oxidized clayey silt down-core Consolidated to unconsolidated down-core, damp	
			53				
			54				
						SOIL/BEDROCK	
	120	25 / 30	55			Silty Claystone Medium dark gray (N 4/0) to dark gray, (N 3/0) Homogeneous unweathered bedrock Minor coal fragments Very well consolidated, damp	
			56				
	80	25 / 20	57			Silty Claystone Dark gray, (N 3/0) Slightly silty, coal fragments throughout Very dense very well consolidated	
			58				
			59				

DRILLING CONTRACTOR

DRILLER

DATE 9/29/87

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 45-87BR

DATE DRILLED: 10/8-16/89 EQUIPMENT: MOBILE B-57

DESCRIPTION BST ELEVATION 5949 42

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
	96	4.0 / 3.8	61			Claystone Dark gray, (N 3/0) with some brownish gray, (5YR 4/1) siltstone nodules Very thin (less than 01') clayey sandstone layer, dark gray, (N 3/0) Rounded, moderate sorting, very fine grained Homogenous, consolidated, moist to wet	
			62				
			63				
			64				
	90	4.0 / 3.8	65			Claystone Same as above Abundant organic fragments abundant silt, trace sand Dense moist to wet	
			66				
			67				
			68				
	80	4.0 / 2.0	69				
			70				
			71				
			72				
	120	2.0 / 2.4	73				
			74				
	83	4.0 / 2.1	75				
			76				
			77				
			78				
	125	4.0 / 5.0	79			Claystone Dark gray, (N 3/0) Abundant siltstone pebbles, brownish gray (5YR 4/1) Angular, dense Very thin sandstone laminations at 81 0, medium dark gray, (N 4/0) Well sorted rounded, very fine grained Abundant organic fragments Unconsolidated, moist	

DRILLING CONTRACTOR Boyles Brothers Drilling

DRILLER

BY LAA

DATE 8/21/87 CHKD BY

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 45-87BR

DATE DRILLED: 10/6-15/87 EQUIPMENT: MOBILE B-57

DESCRIPTION BST ELEVATION 6049 42

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG		TESTS
			81				
	100	4.0 / 4.0	82			Sandy Claystone Dark gray (N 3/0) Sand fine to medium grained rounded quartzose well sorted Abundant organics moist	
			83				
			84			Claystone Dark gray (N 3/0) Gradual change Abundant organic fragments Some sand, similar to above, some siltstone Gradational changes to sandy siltstone siltstone sandy claystone and claystone Unweathered homogenous, dense, moist	
			85				
	100	4.0 / 4.0	86			Claystone Same as above	
			87				
			88				
			89				
	100	4.0 / 4.0	90			Clayey Sandstone Medium dark gray (N 4/0) Rounded, fine to very fine grained well sorted Organics common Consolidated, dense moist to wet	
			91			Clayey Sandstone Medium dark gray (N 4/0) Same as above with very stained (FeO) zone at 93 0 -93 5 light brown (5YR 5/6) From 90 0 - 93 0 small (approx 0 08 thick) beds of claystone Very dense homogenous wet	
			92				
			93				
	83	4.0 / 2.1	94			Sandstone Same as above At 96 0 have medium grained sandstone light gray, (N 7/0) Very stained, light brown (5YR 5/6) Some Fe Mag minerals quartzose sand wet	
			95				
			96				
			97				
	75	4.0 / 3.0	98			Sandstone Medium light gray, (N 6/0) Medium to fine grained Calcareous cement, reacts strongly with HCl Very dense Oxidized in areas Very broken with claystone fragments Angular, wet	
			99				

DRILLING CONTRACTOR

DRILLER

THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED

LOG OF BORING No. 45-87BR

Page 6 of 6

DATE DRILLED 10/6-15-87 EQUIPMENT MOBILE B-57

DESCRIPTION BST ELEVATION 5949 42

SAMPLE NO / SAMPLE TYPE	PERCENT RECOVERY	FEET DRIVEN / FEET SAMPLED	DEPTH IN FEET	WELL OR PIEZOMETER CONSTRUCTION	GRAPHIC LOG	DESCRIPTION	TESTS
			101			Sandstone Medium light gray, (N 6/0), with light brown, (5YR 5/6) and moderate yellowish brown, (10YR 5/4) stains (FeO) Fine to very fine grained Moist	
						Siltstone Medium light gray, (N 6/0) Trace very fine grained sand Homogenous, moist	
	100	4.0 / 4.0	102			Sandy Siltstone Medium light gray (N 6/0) Trace fine grained sand Moist	
			103				
			104			Siltstone Medium light gray (N 6/0) Alternating beds of sandstone siltstone and claystone Sandstone layers up to 2 thick siltstone and claystone layers less than 2 thick moist	
			105				
			106				
	100	4.0 / 4.0				Siltstone Medium light gray, (N 6/0) Some very fine grained sand some clay, some organics Moist	
			107				
			108				
						Sandy Siltstone Medium light gray (N 6/0) Some clay Fine to medium grained sand, rounded, well sorted Dense moist	
			109				
			110				
	100	2.0 / 2.0				Sandy Siltstone Medium light gray (N 6/0) Some very fine sand, some clays Homogenous consolidated moist	
			111				
			112			Total Depth of Borehole 112.0 ft	
			113				
			114				
			115				
			116				
			117				
			118				
			119				

DRILLING CONTRACTOR Boyles Brothers Drilling Co

DRILLER T. Hight

BY LAA

DATE 6/21/88 CHKD BY

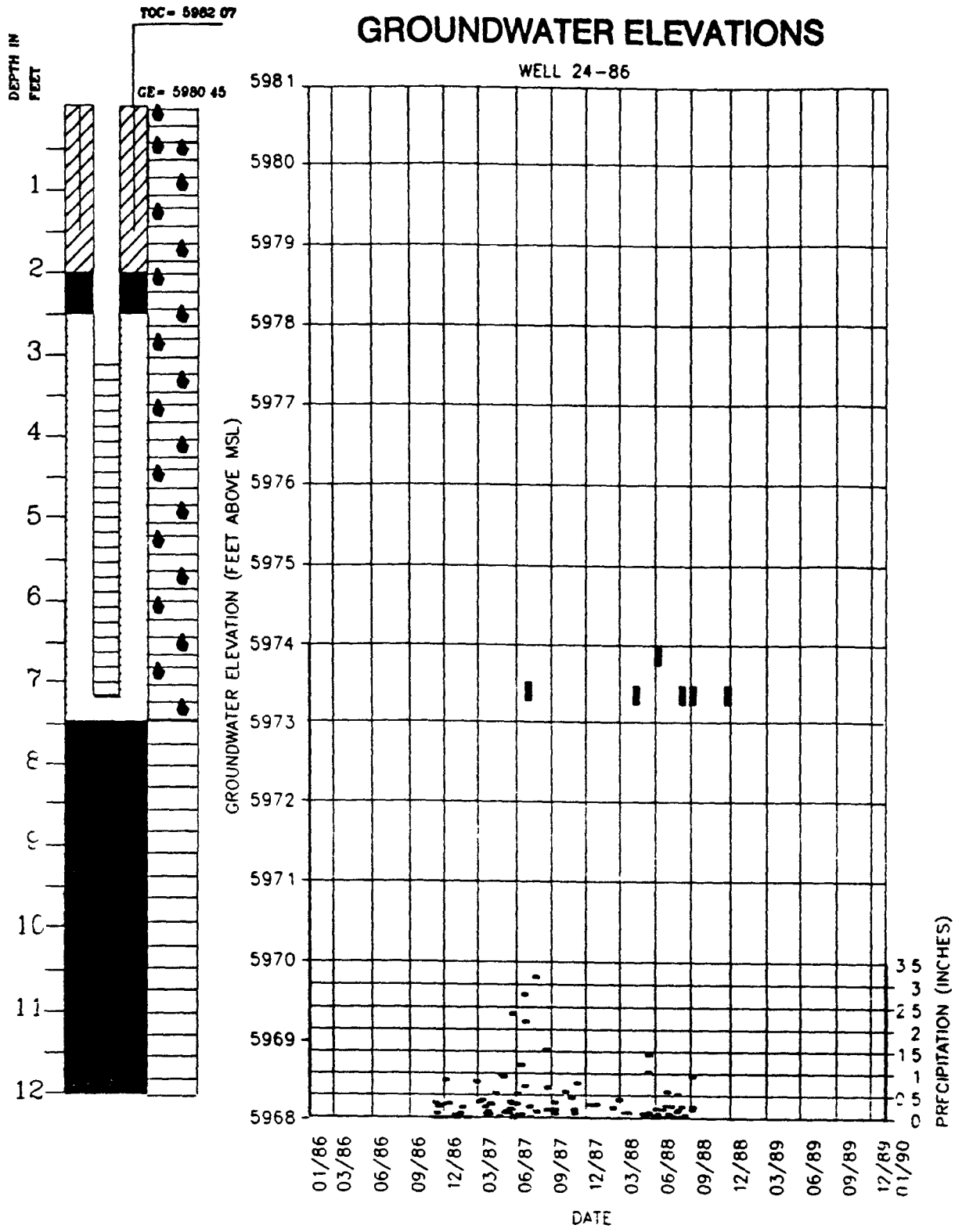
THIS SUMMARY APPLIES ONLY AT THE LOCATION AND TIME OF DRILLING. SUBSURFACE CONDITIONS MAY CHANGE AT THIS LOCATION WITH THE PASSAGE OF TIME. THE DATA PRESENTED IS A SIMPLIFICATION OF ACTUAL CONDITIONS ENCOUNTERED.

APPENDIX C

HYDROGRAPHS FOR WELLS IN THE AREA OF PAD 904

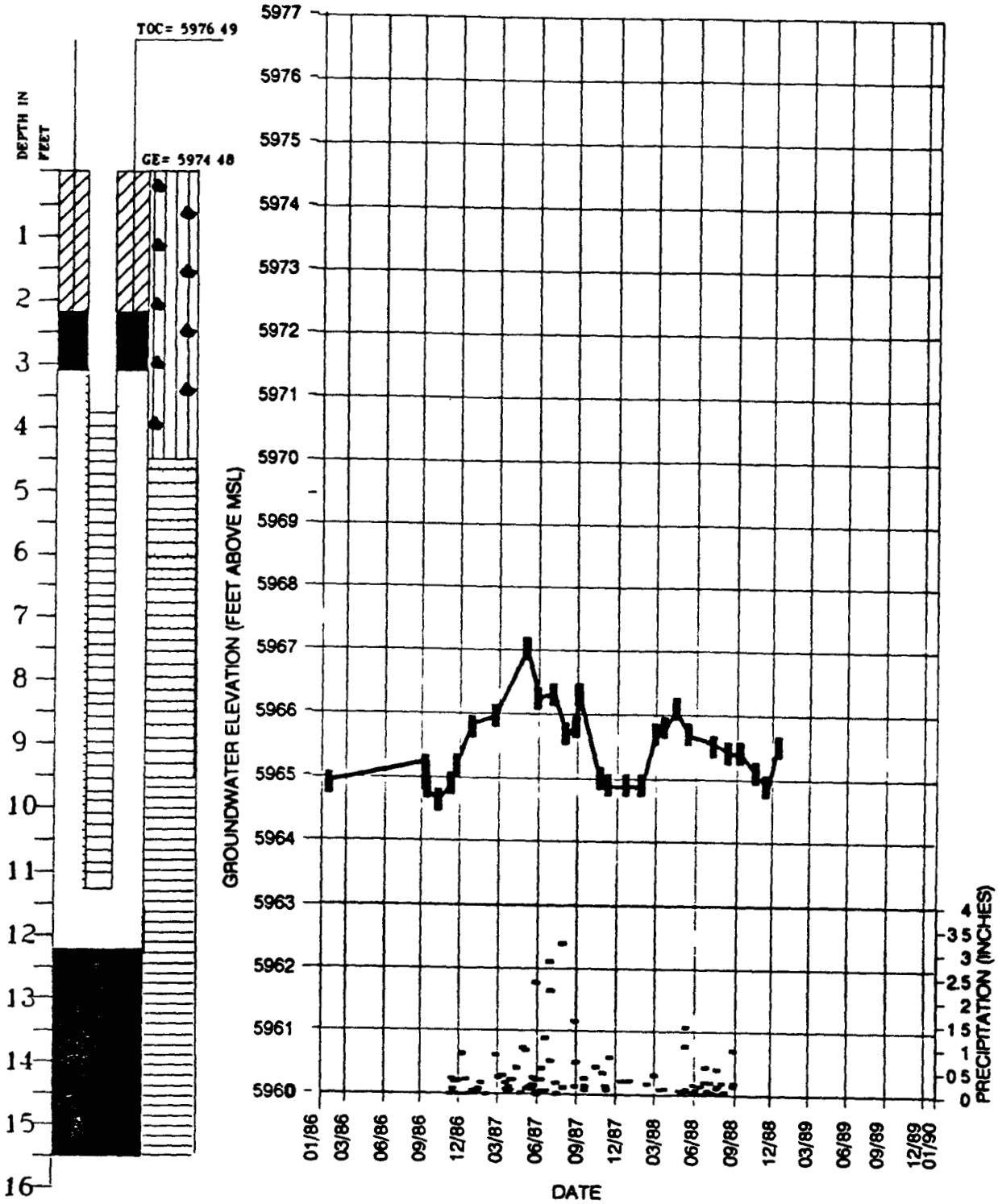
HYDROGRAPHS FOR ALLUVIAL WELLS

24-86	4-87
26-86	10-87
33-86	15-87
61-86	44-87


GROUNDWATER ELEVATIONS
WELL 24-86
TOC= 5982 07
GE= 5980 45
DEPTH IN FEET
1
2
3
4
5
6
7
8
9
10
11
12
GROUNDWATER ELEVATION (FEET ABOVE MSL)
5981
5980
5979
5978
5977
5976
5975
5974
5973
5972
5971
5970
5969
5968
PRECIPITATION (INCHES)
3 5
3
2 5
2
1 5
1
0 5
0
01/86
03/86
06/86
09/86
12/86
03/87
06/87
09/87
12/87
03/88
06/88
09/88
12/88
03/89
06/89
09/89
12/89
01/90
DATE

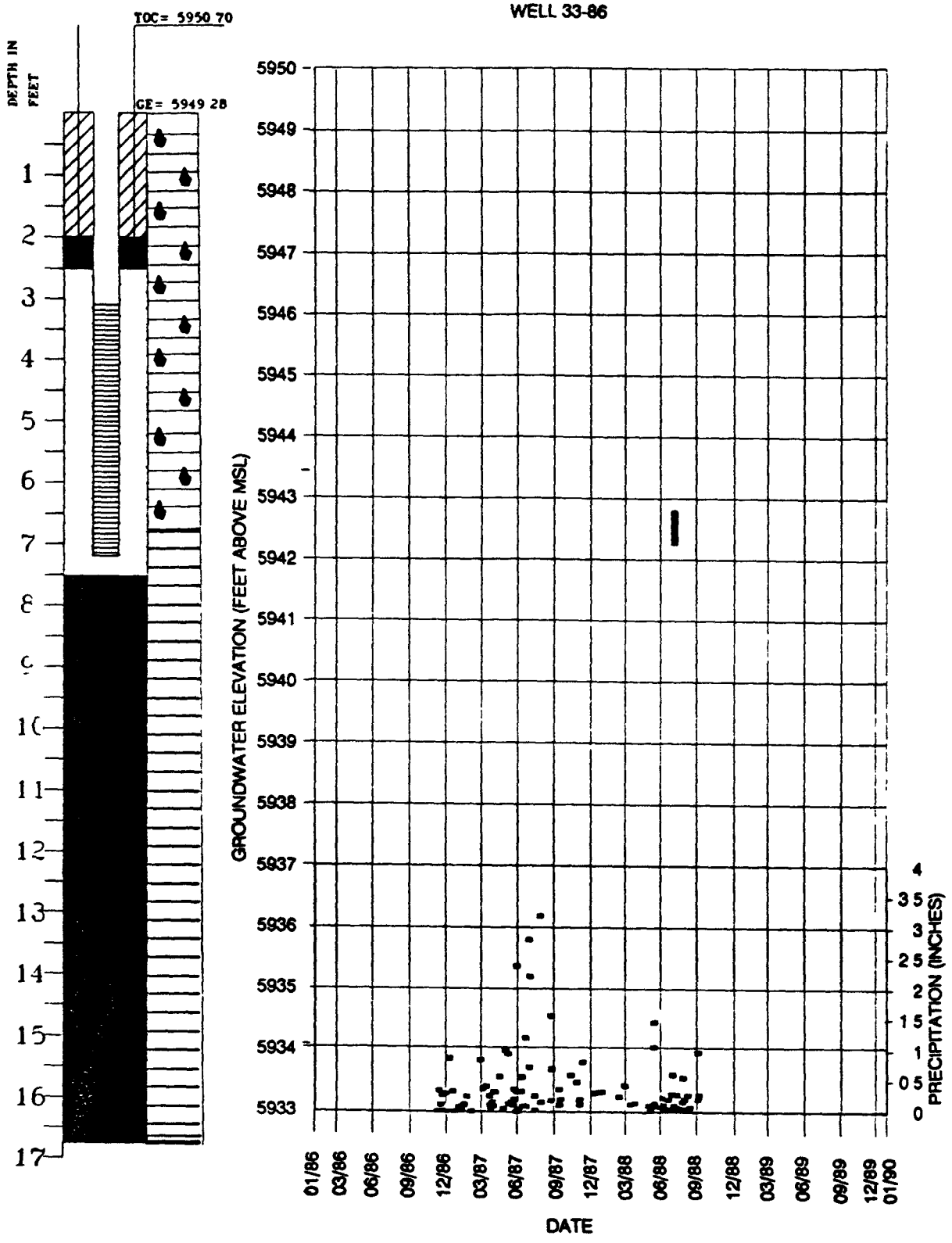
GROUNDWATER ELEVATIONS

WELL 26-86

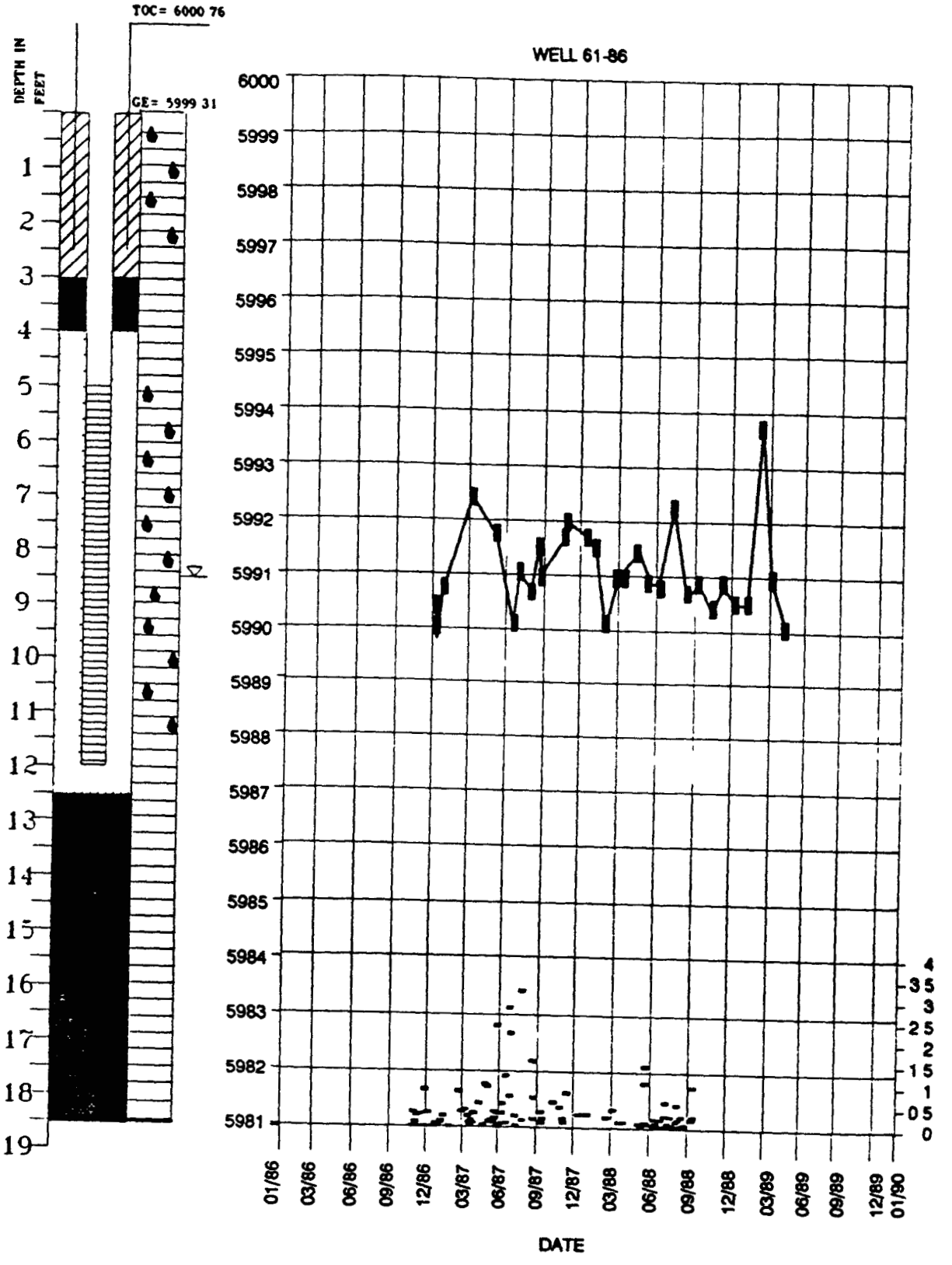


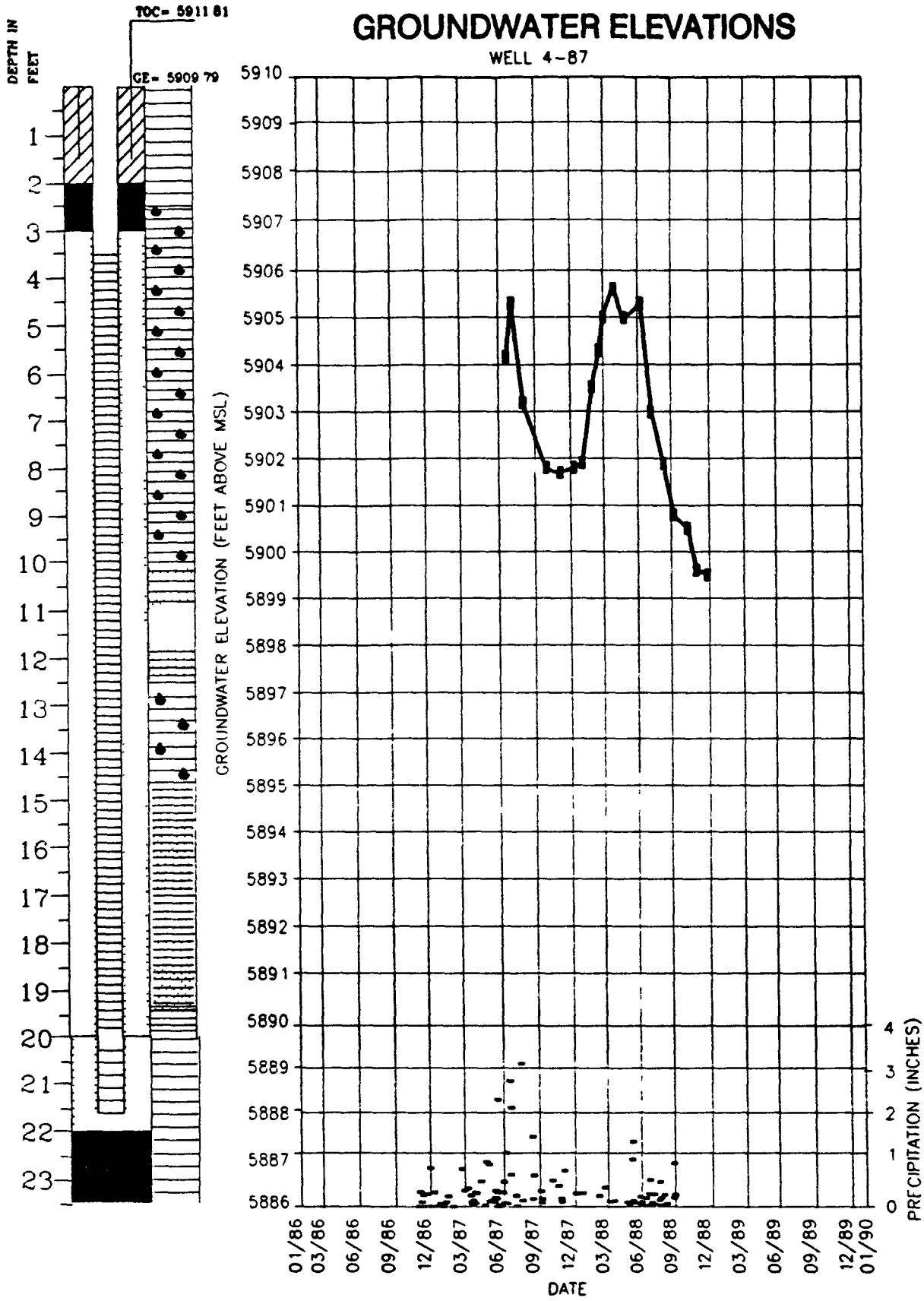
GROUNDWATER ELEVATIONS

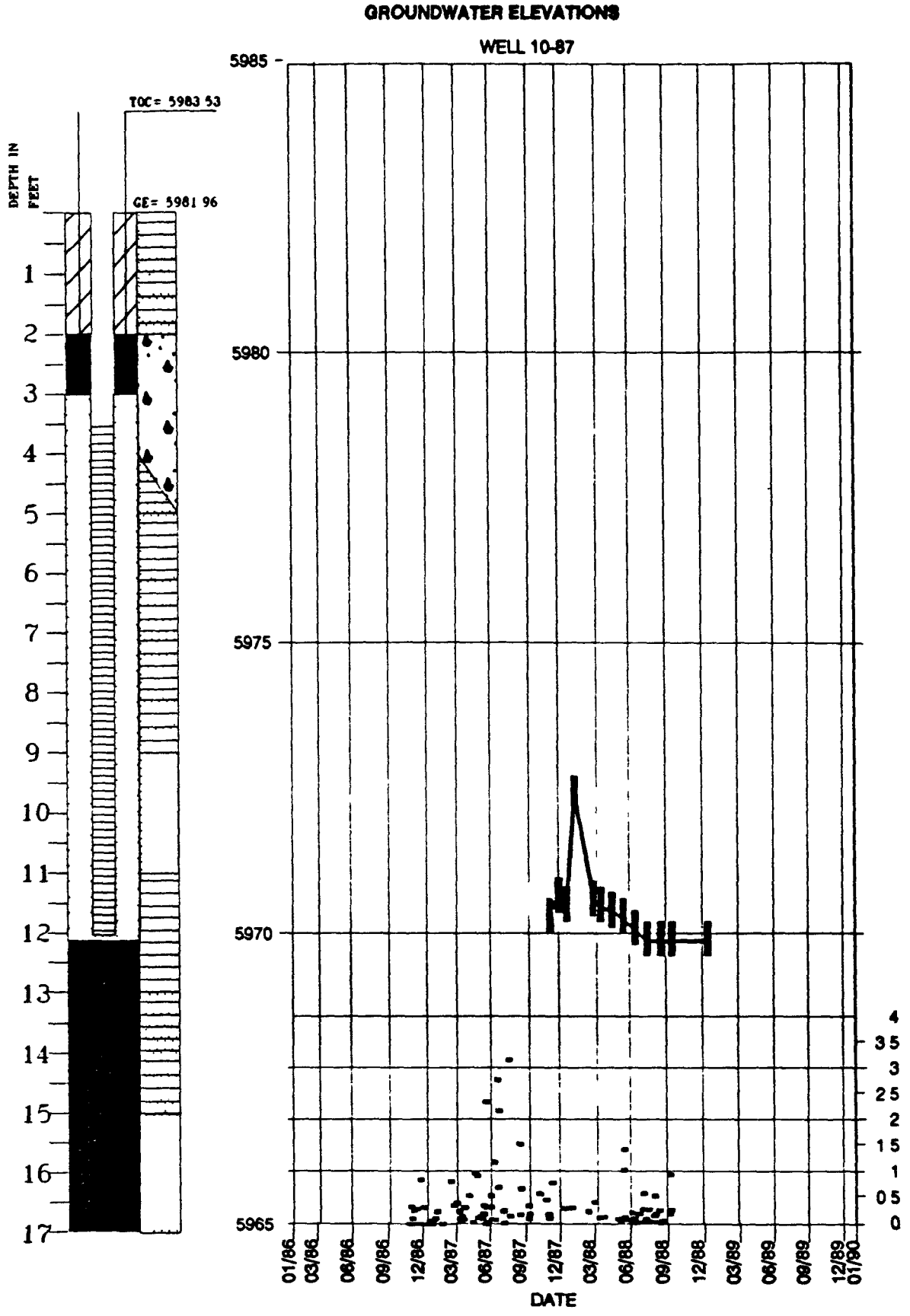
WELL 33-86



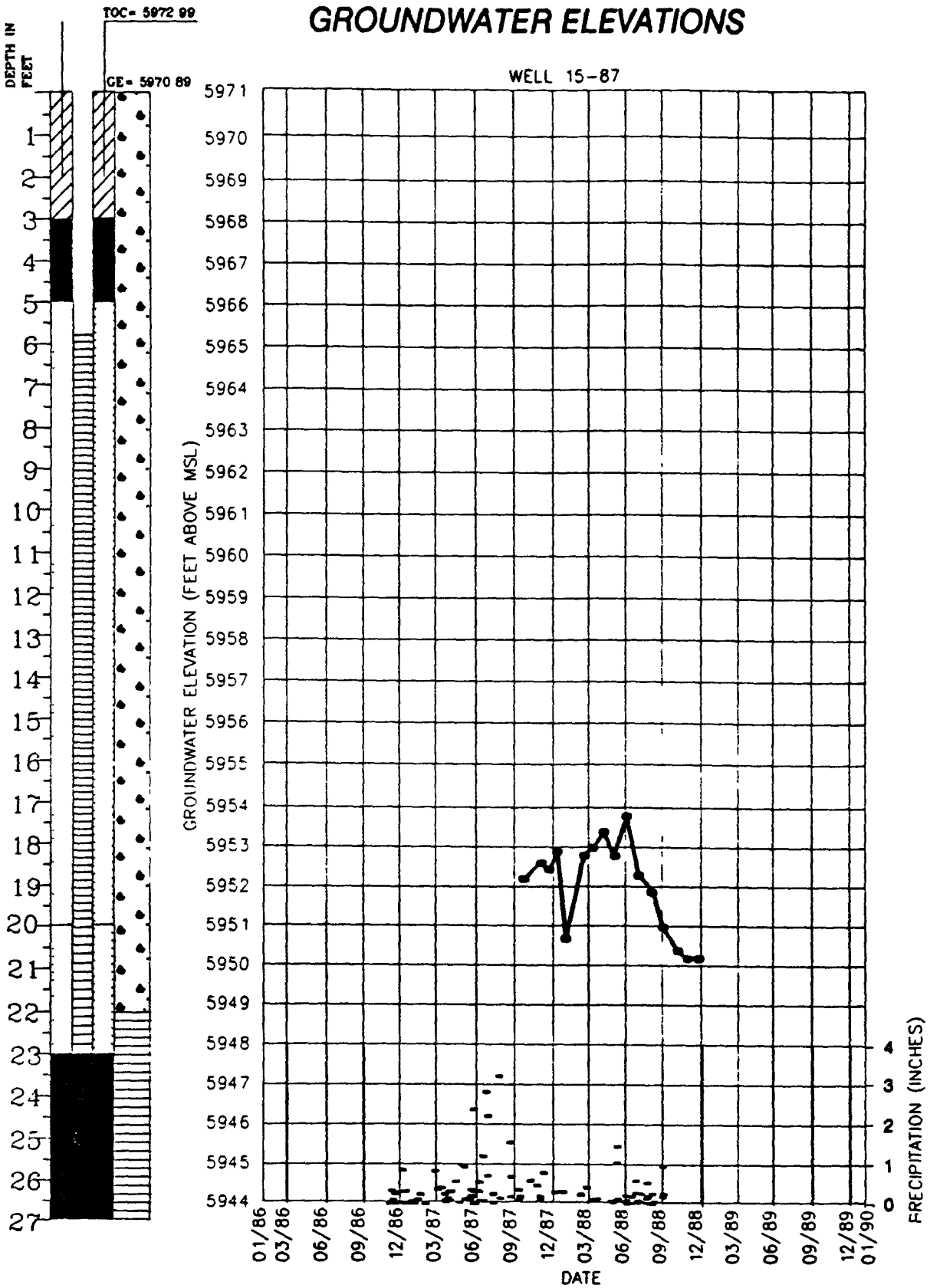
GROUNDWATER ELEVATIONS

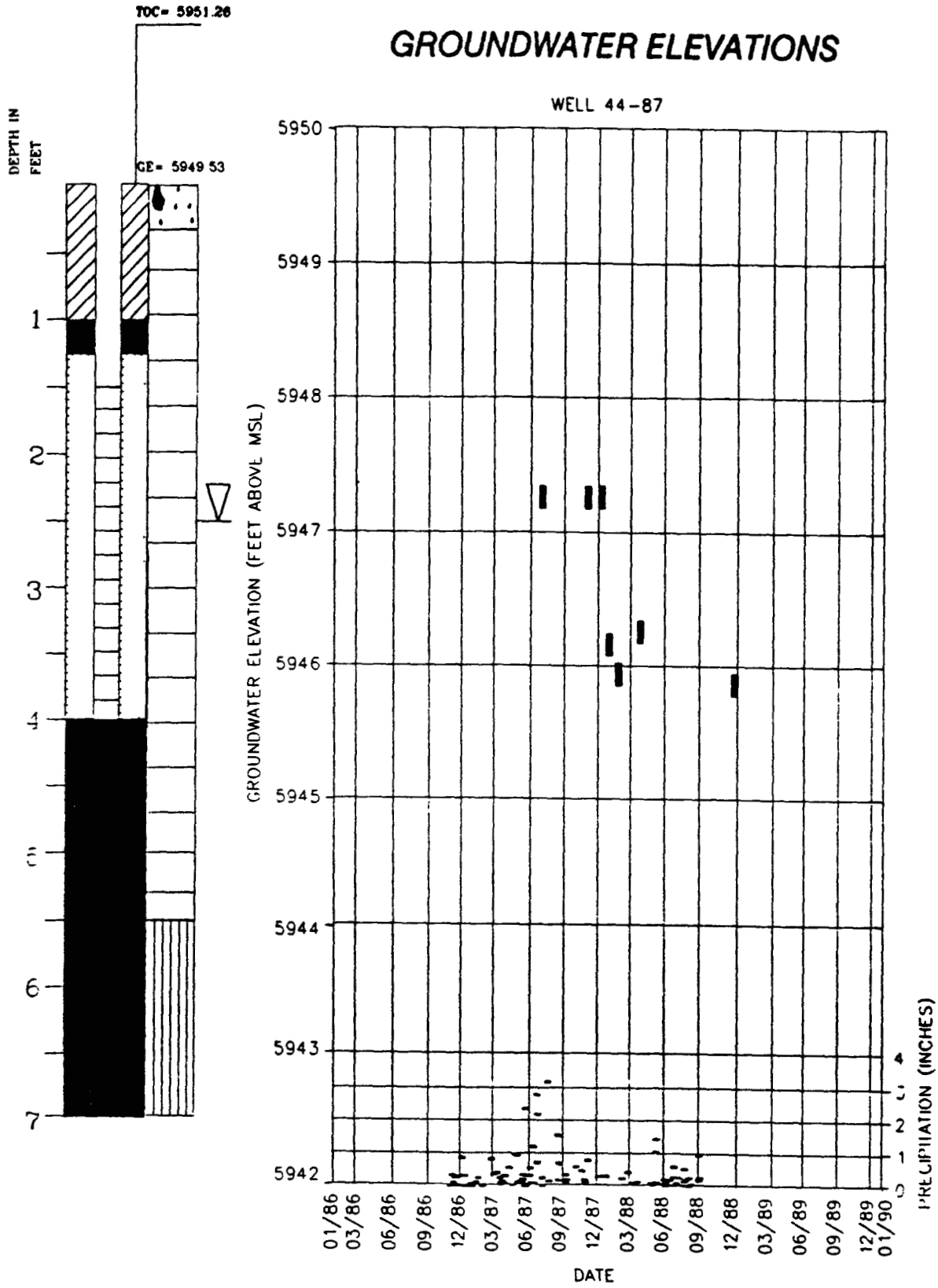



GROUNDWATER ELEVATIONS
WELL 4-87
TOC= 5911.81
GE= 5909.79
DEPTH IN FEET
GROUNDWATER ELEVATION (FEET ABOVE MSL)
PRECIPITATION (INCHES)
DATE
5910
5909
5908
5907
5906
5905
5904
5903
5902
5901
5900
5899
5898
5897
5896
5895
5894
5893
5892
5891
5890
5889
5888
5887
5886
01/86
03/86
06/86
09/86
12/86
03/87
06/87
09/87
12/87
03/88
06/88
09/88
12/88
03/89
06/89
09/89
12/89
01/90


GROUNDWATER ELEVATIONS
WELL 10-87
TOC= 5983 53
GE= 5981 96
DEPTH IN FEET
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
5985
5980
5975
5970
5965
4
3 5
3
2 5
2
1 5
1
0 5
0
01/86
03/86
06/86
09/86
12/86
03/87
06/87
09/87
12/87
03/88
06/88
09/88
12/88
03/89
06/89
09/89
12/89
01/90
DATE

GROUNDWATER ELEVATIONS

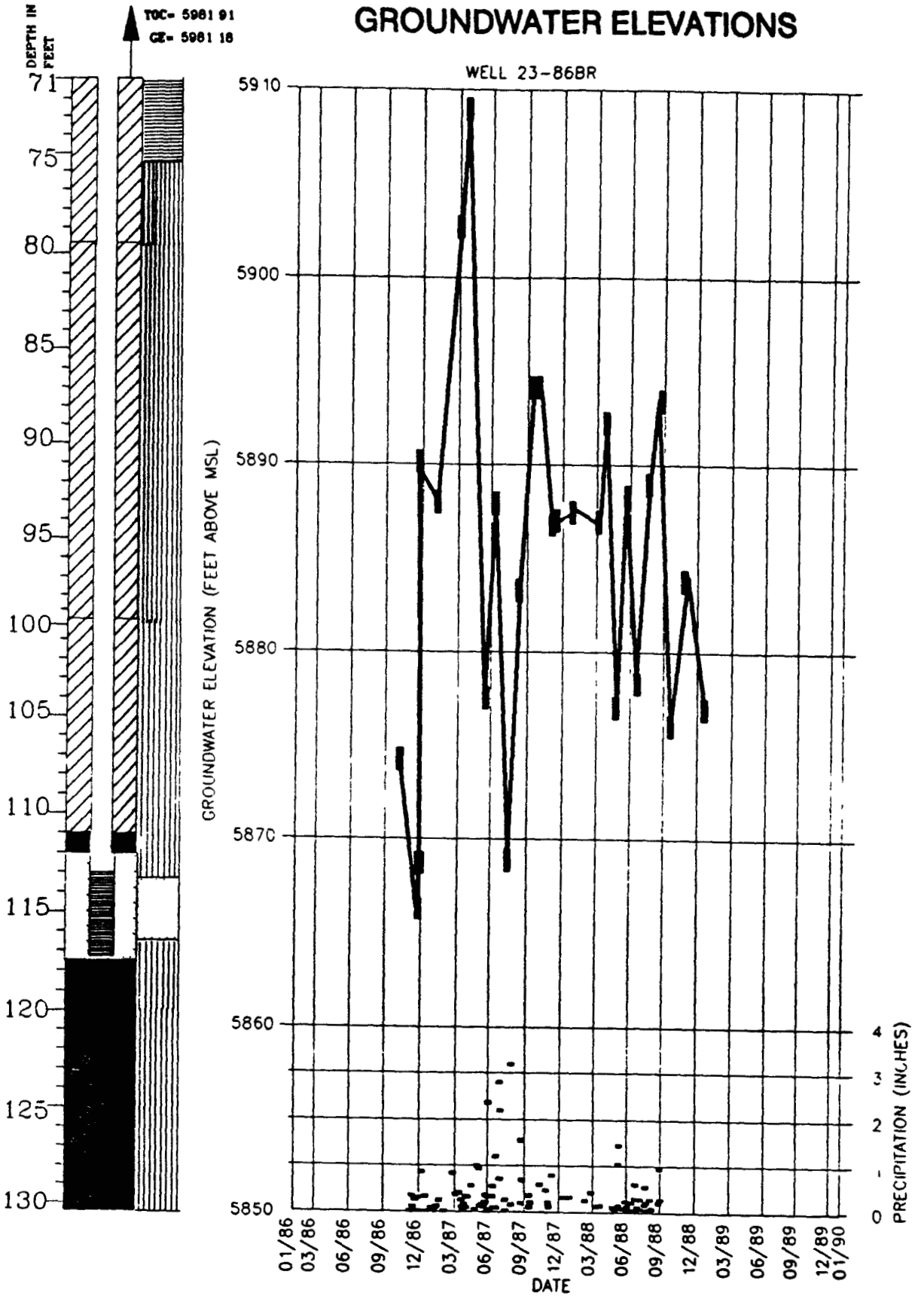


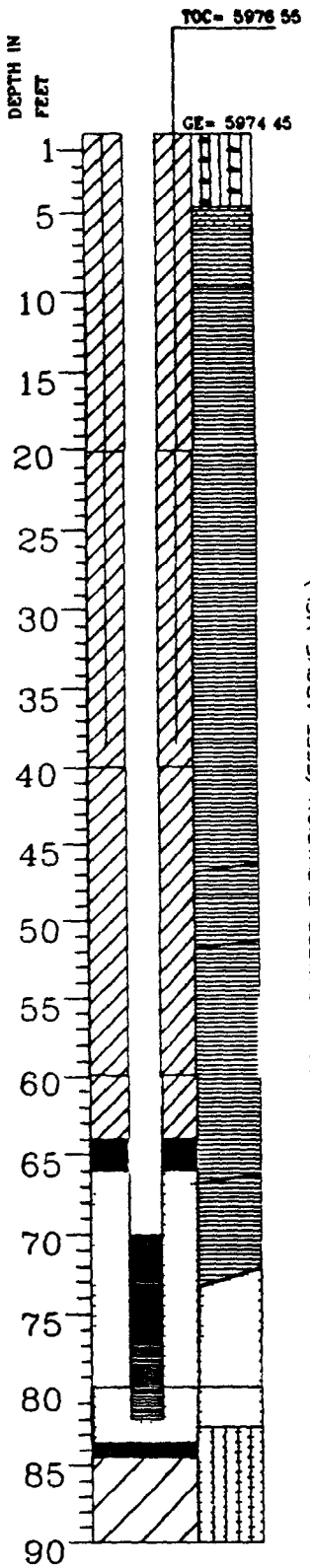

GROUNDWATER ELEVATIONS
WELL 44-87
TOC= 5951.26
GE= 5949.53
DEPTH IN FEET
1
2
3
4
6
7
GROUNDWATER ELEVATION (FEET ABOVE MSL)
5950
5949
5948
5947
5946
5945
5944
5943
5942
PRECIPITATION (INCHES)
4
2
1
0
01/86
03/86
06/86
09/86
12/86
03/87
06/87
09/87
12/87
03/88
06/88
09/88
12/88
03/89
06/89
09/89
12/89
01/90
DATE

HYDROGRAPHS FOR BEDROCK WELLS

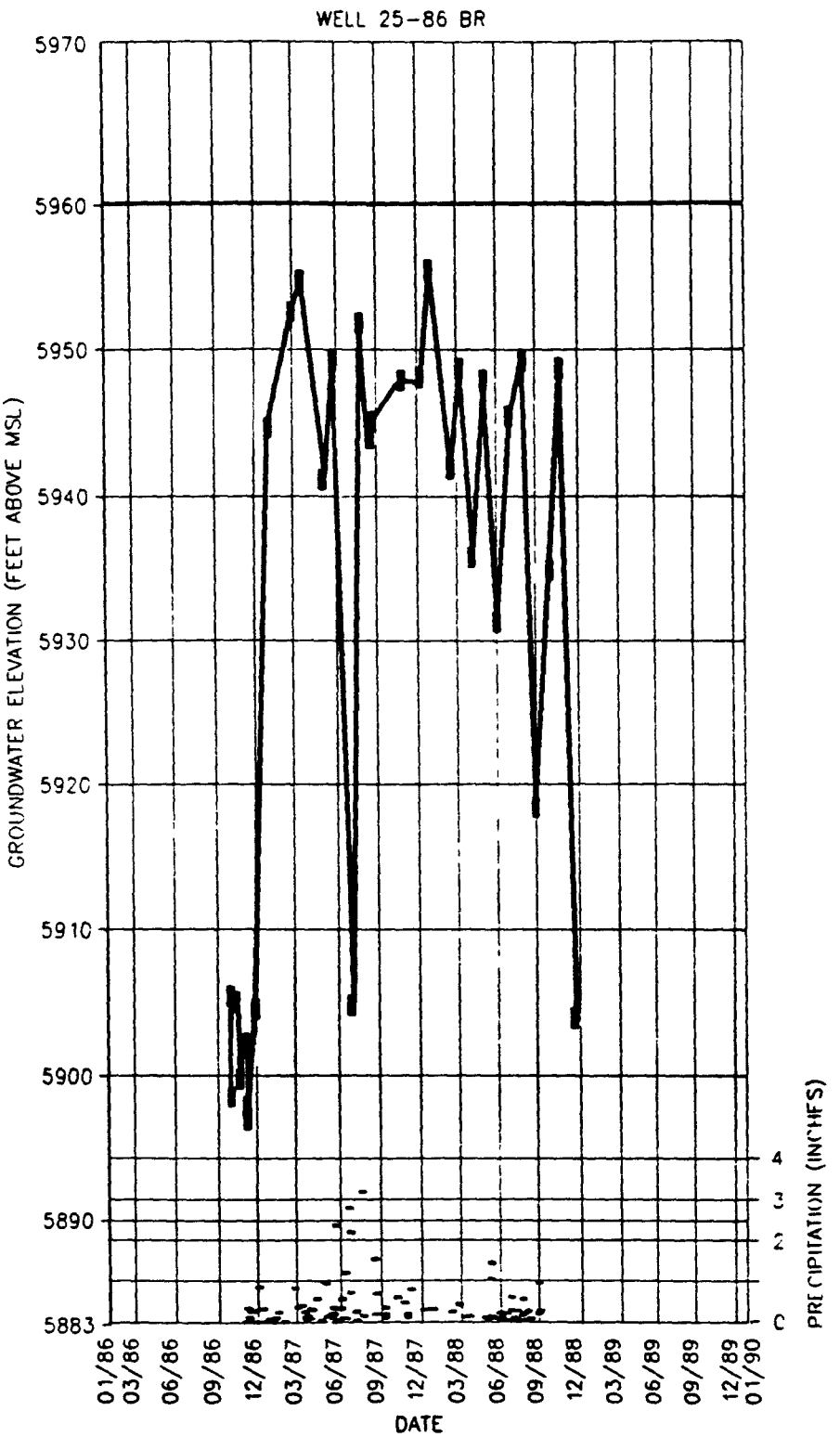
23-86BR
25-86BR
[redacted]
5-87BR
9-87BR
16-87BR
[redacted]
45-87BR

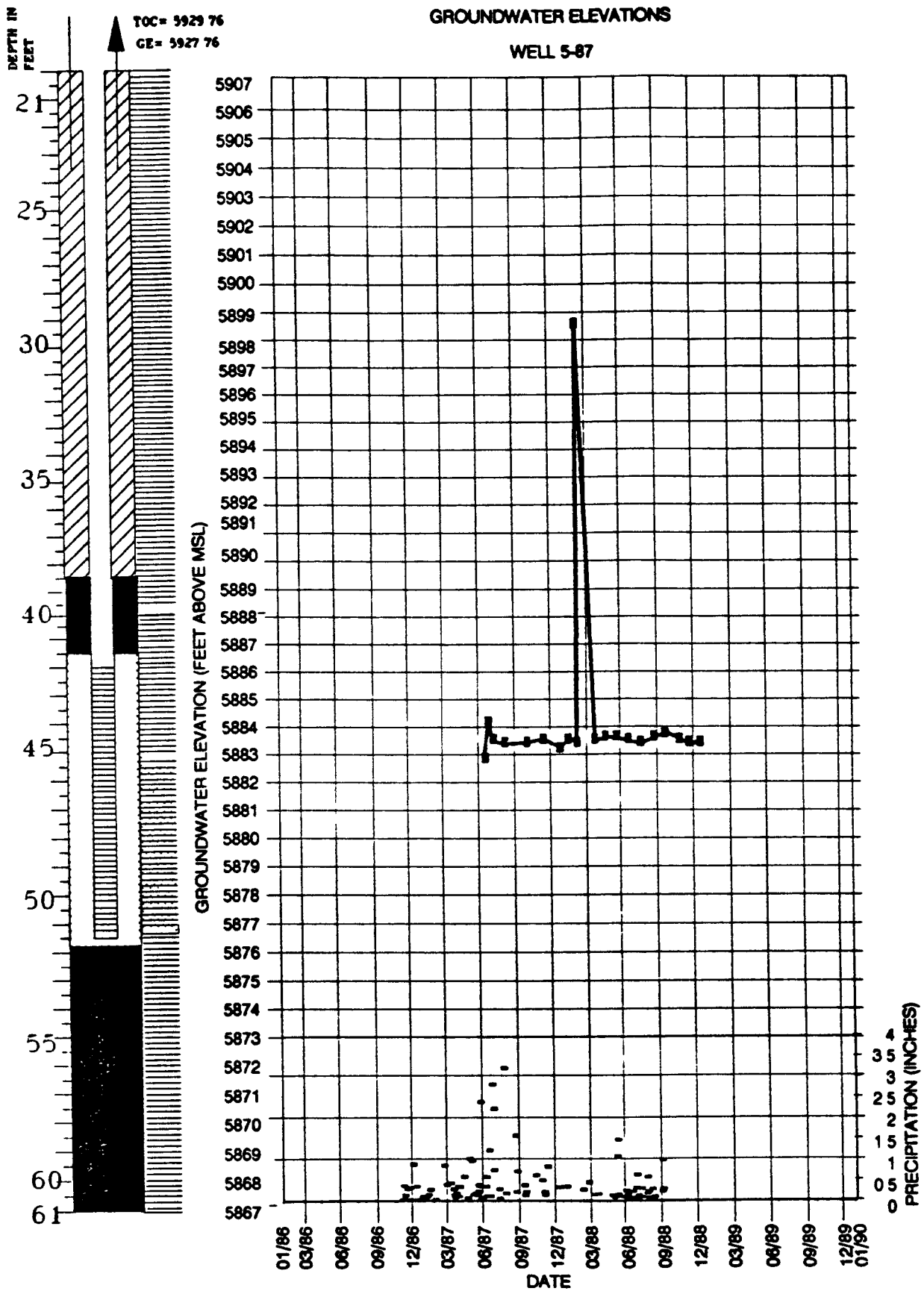
GROUNDWATER ELEVATIONS

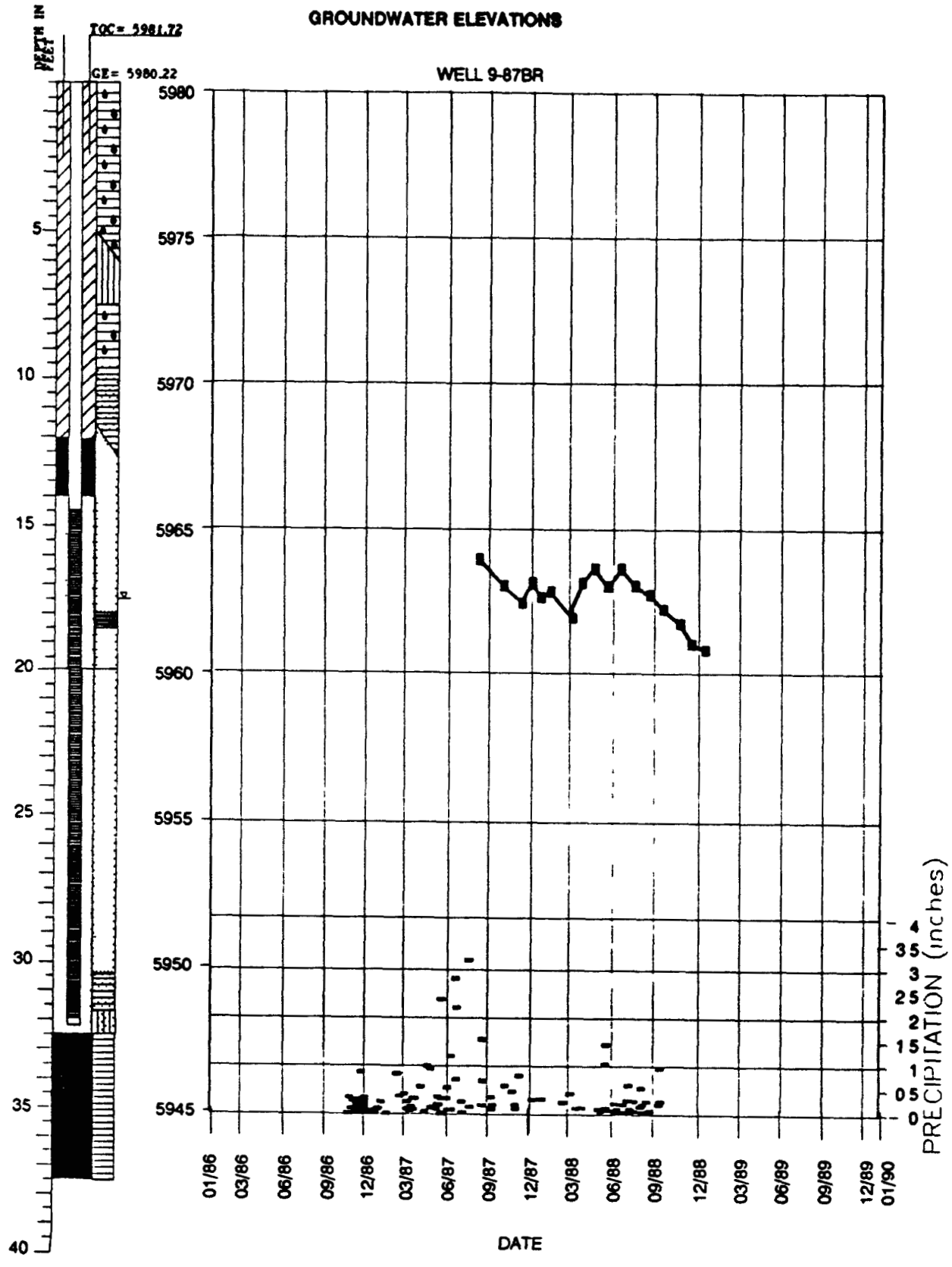


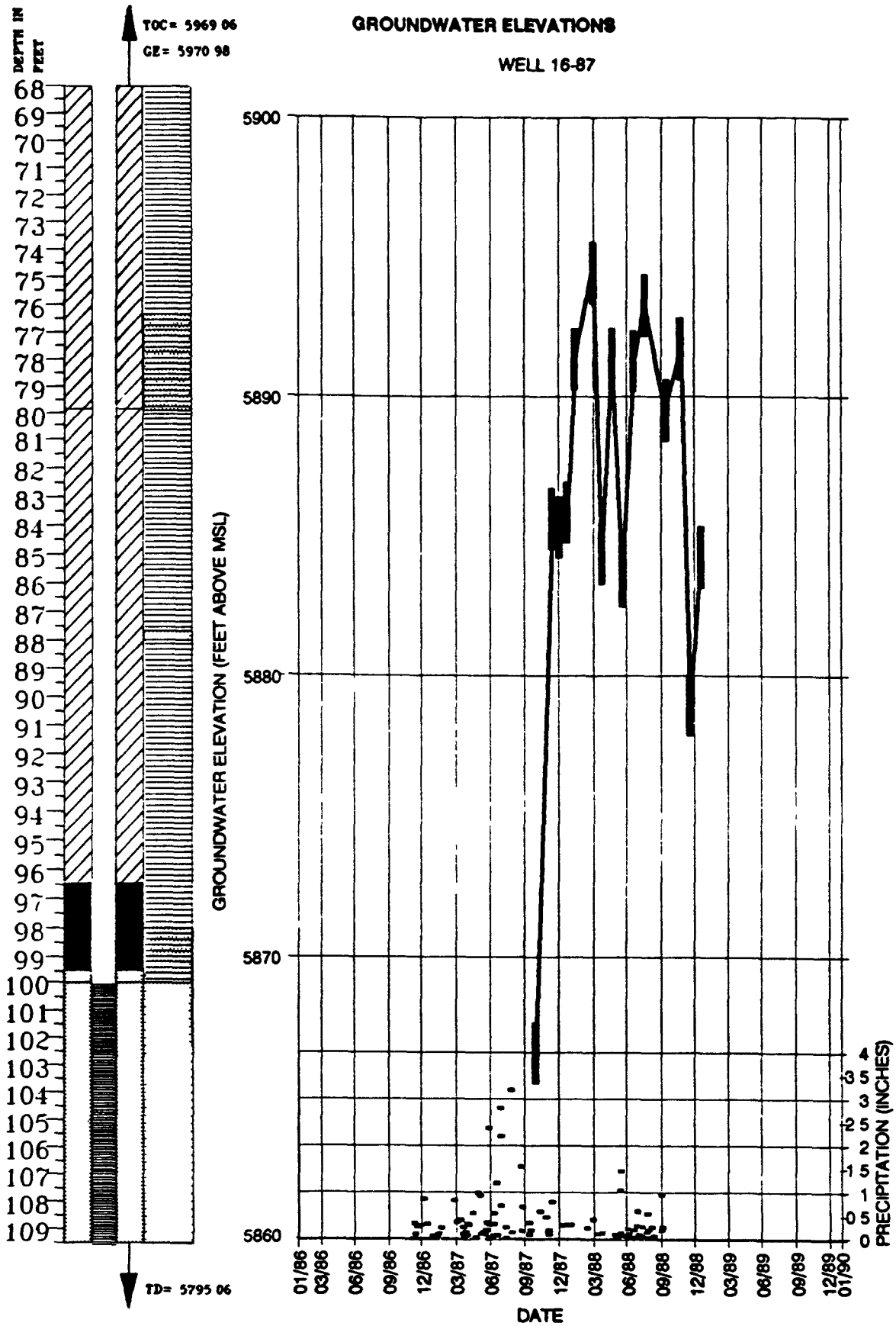


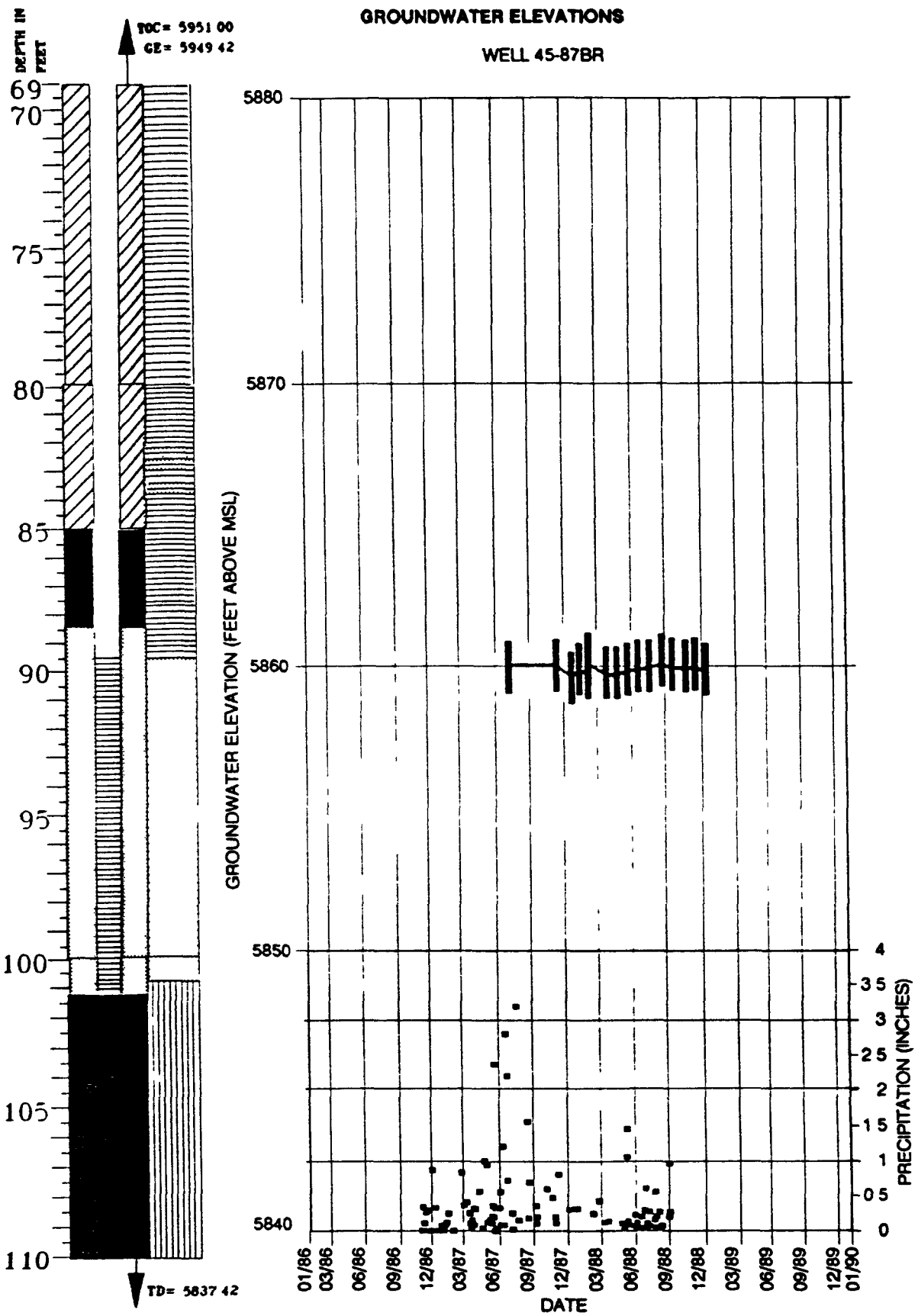
GROUNDWATER ELEVATIONS




GROUNDWATER ELEVATIONS
WELL 5-87
DEPTH IN FEET
TOC= 5929 76
GE= 5927 76
21
25
30
35
40
45
50
55
60
61
GROUNDWATER ELEVATION (FEET ABOVE MSL)
5907
5906
5905
5904
5903
5902
5901
5900
5899
5898
5897
5896
5895
5894
5893
5892
5891
5890
5889
5888
5887
5886
5885
5884
5883
5882
5881
5880
5879
5878
5877
5876
5875
5874
5873
5872
5871
5870
5869
5868
5867
01/86
03/86
06/86
09/86
12/86
03/87
06/87
09/87
12/87
03/88
06/88
09/88
12/88
03/89
06/89
09/89
12/89
01/90
DATE
PRECIPITATION (INCHES)
4
3.5
3
2.5
2
1.5
1
0.5
0


GROUNDWATER ELEVATIONS
WELL 9-87BR
DEPTH IN FEET
TOC= 5981.72
GE= 5980.22
5980
5975
5970
5965
5960
5955
5950
5945
5
10
15
20
25
30
35
40
01/86
03/86
06/86
09/86
12/86
03/87
06/87
09/87
12/87
03/88
06/88
09/88
12/88
03/89
06/89
09/89
12/89
01/90
DATE
PRECIPITATION (inches)
0
05
1
15
2
25
3
35
4


GROUNDWATER ELEVATIONS
WELL 16-87
DEPTH IN FEET
TOC= 5969 06
GE= 5970 98
TD= 5795 06
68
69
70
71
72
73
74
75
76
77
78
79
80
81
82
83
84
85
86
87
88
89
90
91
92
93
94
95
96
97
98
99
100
101
102
103
104
105
106
107
108
109
GROUNDWATER ELEVATION (FEET ABOVE MSL)
5900
5890
5880
5870
5860
PRECIPITATION (INCHES)
4
3.5
3
2.5
2
1.5
1
0.5
0
01/86
03/86
06/86
09/86
12/86
03/87
06/87
09/87
12/87
03/88
06/88
09/88
12/88
03/89
06/89
09/89
12/89
01/90
DATE


GROUNDWATER ELEVATIONS
WELL 45-87BR
DEPTH IN FEET
TOC= 5951 00
GE= 5949 42
TD= 5837 42
69
70
75
80
85
90
95
100
105
110
GROUNDWATER ELEVATION (FEET ABOVE MSL)
5880
5870
5860
5850
5840
PRECIPITATION (INCHES)
4
3 5
3
2 5
2
1 5
1
0 5
0
01/86
03/86
06/86
09/86
12/86
03/87
06/87
09/87
12/87
03/88
06/88
09/88
12/88
03/89
06/89
09/89
12/89
01/90
DATE

APPENDIX D

MONTHLY PONDCRETE STATUS REPORTS

Department of Energy
Albuquerque Operations Office
P O Box 5400
Albuquerque, New Mexico 87115

OCT 31 1988

Mr David Shelton
Hazardous Materials and Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Dear Mr Shelton

Per Gary Baughman's letter of October 10, 1988, enclosed is the first monthly report describing the progress and activities associated with the repackaging of pondcrete at the Rocky Flats Plant This report covers activities related to pondcrete for the period of September 10, 1988 through October 20, 1988

If you have any questions or comments on this report, please refer them to Rich Schassburger of my staff on 966-2762.

Sincerely,

[illegible]

Albert E. Whiteman
Area Manager

Enclosure

cc
Robert Duprey, EPA
Jim Wilson, Rocky Flats Monitoring Council

Status Report For Pondcrete Operations (through October 20, 1988)

- o Building 788 (processing area)
  - Installation of flowmeter completed
  - Thirteen (13) new triwall (cardboard) boxes processed for testing of process control
  - Fourteen (14) plywood boxes (2'x4'x7') filled with triwall boxes (2 triwalls per plywood box)
    - o Ten (10) new triwalls placed into plywood boxes
    - o Eighteen (18) old triwalls placed into plywood boxes
  - Three (3) plywood boxes "capped" with new pondcrete (voids filled)
  - Three (3) destabilized boxes pumped into clarifier (reslurried)
  - Five (5) operators recertified on new processing system
- o Storage Pad 750
  - Inspections ongoing
  - No leaks or spills
- o Storage Pad 904
  - Leaking box identified on 9/19/88
  - Suspect box and two others overpacked into metal waste crate
  - Nine (9) stacks of three-high triwalls restacked to two-high configuration
  - Several leaning stacks shored up with jacks
  - Inspection ongoing (no new problems)
- o Procedures
  - Quality Assurance Plan - Pondcrete Process (WO-4050), new
  - Rework of Triple Walled Pondcrete Boxes (WO-4052), new
  - Packaging and Shipping Solar Pond Sludge (WO-4036); modified
  - Removal of Triple Walled Pondcrete Boxes from the Storage Pads (WO-4053); new
- o Summary reports - Attached

SUMMARY REPORT - AUGUST 27 - SEPTEMBER 9, 1988

A status report on pondcrete activities for the period August 27, 1988 through September 9, 1988 is provided Summary information is included on maintenance activities, waste form testing and the Quality Assurance Plan.

Installation of a process flowmeter is continuing. Pipe fabrication has been completed and approved through NDT of the pieces. Installation of the flowmeter and associated piping is complete; electrical connections and inspection remain to be completed.

Partial results have been received on a matrix experiment to correlate penetrometer readings of solidified pondcrete to ASTM test method D4359-84 and to EPA Paint Filter Test. Water-to-cement ratios in the range of 1 5 to 4 0 were tested on three slurry solids loading levels (15 wt%, 17 5 wt% and 20 wt%) All samples were classified as solids by the EPA Paint Filter Test. The ASTM test has been performed at 17.5 wt% solids and all samples were determined to be solids. Additional ASTM tests at 15 wt% and 20 wt% solids are ongoing.

A Quality Assurance Plan (QAP) for the Pondcrete Process has been written and approved The QAP incorporates the eighteen elements of NQA-1 Section 9 of the QAP contains the process control requirements to assure that future pondcrete waste forms will be consistently acceptable Penetrometer testing provides the final acceptance of the waste form

SUMMARY REPORT - SEPTEMBER 10 - SEPTEMBER 27, 1988

A status report on pondcrete activities for the period September 10, 1988 through September 27, 1988 is provided Summary information is included on upgrades to the continuous process, UOR status, and design activities

Upgrades to the continuous pug-mill mixing process for pondcrete were completed and final inspection approval was made on September 27, 1988. A meter was installed to measure the thickened slurry flow to the pug-mill for determination of approximate water:cement ratios. Quality Plan verification of the system is now scheduled to be conducted through October 5, 1988, and preparation of Qualification and Test Shipment containers will follow.

Actions to satisfy the UOR recommendations have been completed. The pondcrete operators have been recertified to new training requirements The training qualification standards program includes process description, flowsheet, detailed components and emergency conditions followed by a written test Also, Nevada Operations has given formal approval, with a minor recommendation, to the "Repackaging and Reprocessing Plan" to complete that UOR recommendation.

Design activities are proceeding on a pondcrete curing facility and reprocessing A Title II review was held on September 27, 1988, concerning a building at the 904 pad for pondcrete curing. The design concept for reprocessing of unacceptable pondcrete blocks has been finalized Procurement of a skid-mounted batch mixer has been initiated An existing concrete pumper will be used to transfer a slurry of unacceptable blocks and water to the batch-mixer. Loading of the concrete pumper will initially be manually performed. The operating history will be used to define additional head-end processing techniques.

SUMMARY REPORT - SEPTEMBER 28 - OCT 12, 1988

This report provides a summary of pondcrete activities for the period September 28, 1988 through October 12, 1988 Information is included on a readiness review meeting and on startup activities.

A readiness review meeting was held on October 5, 1988 to discuss readiness of operational procedures; the status of UOR actions, the fulfillment of DOE/RFAO actions, the status and readiness of the facility, and operational data acquired during flowmeter testing. The significant issues raised during the meeting were: 1) to provide DOE with a copy of all documentation such as operating procedures, inspection procedures, waste form testing data and the OSA and 2) to obtain additional operating data before preparation of the test shipment containers.

Testing was performed on the continuous pug-mill pondcrete process at Building 788 to verify that the process can be controlled to produce an acceptable waste form A flowmeter has been added for determination of sludge feed rate to the pug-mill. Additionally cement flow from the cement hopper is metered using a constant volume rotary air lock feeder (star valve) The cement flow rate is verified at the beginning of each shift. Test data are shown in the table for the thirteen triwall boxes filled.

Initial testing of six boxes was performed with a target water-to-cement ratio of 2 to 1 Penetrometer testing of the blocks shows that one of the blocks was marginally acceptable, therefore the target water-to-cement ratio was lowered to 1 5 to 1. Production of seven additional boxes to satisfy the readiness review issue indicatec that the sludge and cement flows were readily controlled and that penetrometer testing verified good mixtures The Quality Assurance Plan is being revised to reflect the lower water-to-cement ratio established during these full-scale verification. All procedures and training requirements are in place for the Qualification and Shipment Test Program.

Pondcrete Startup Testing

Date - Box #	Cement Feed Rate (lb/min)	Target Water to Cement Ratio	Actual Water to Cement Ratio	Penetrometer Unconfined Comp. Strength 24 hrs	48 hrs	72 hrs	96 hrs	120 hr
9/28 - 1	36 ± 5	2.0	1.8	4000	8000	--	--	9000+
9/28 - 2	36 ± 5	2.0	2.3	0	1000	--	--	1000
9/28 - 3	36 ± 5	2.0	1.9	4000	8000	--	--	9000+
9/28 - 4	36 ± 5	2.0	2.0	4000	4000	--	--	9000+
9/28 - 5	36 ± 5	2.0	2.0	500	1000	--	--	4000
9/28 - 6	36 ± 5	2.0	1.5	2000	5000	--	--	9000+
9/30 - 1	36 ± 5	1.5	0.9	--	--	9000+	---------->	
10/7 - 1	36 ± 5	1.5	1.5	9000+	---->			
10/7 - 2	36 ± 5	1.5	1.5	9000+	---->			
10/7 - 3	36 ± 5	1.5	1.4	9000+	---->			
10/7 - 4	36 ± 5	1.5	1.4	9000+	---->			
10/7 - 5	36 ± 5	1.5	1.4	9000+	---->			
10/6 - 6	36 ± 5	1.5	1.6	4000	9000+	---->		

Department of Energy

ALBUQUERQUE OPERATIONS
ROCKY FLATS AREA OFFICE
P O BOX 928
GOLDEN, COLORADO 80402-0928

NOV 29 1988

Mr David C Shelton
Director, Hazardous Materials
and Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Dear Mr Shelton:

Transmitted herewith is the second status report on the pondcrete operations which were conducted at the U. S Department of Energy's Rocky Flats Plant from October 12, 1988 through November 17, 1988 The report is being submitted in accordance with the written request from Mr Gary Baughman of your staff dated October 10, 1988.

Questions concerning the content of the report can be directed to Ms Candice Jierree of my staff at 966-4888.

Sincerely,

[illegible]

Albert E Whiteman
Area manager

Enclosure

cc w/encl
Robert Duprey, EPA
James Wilson, Rocky Flats Monitoring Council
Tod Anderson, RFAO

STATUS REPORT FOR PONDCRETE OPERATIONS (THROUGH NOVEMBER 20, 1988)

- Building 788 (processing area)
  - Three (3) plywood boxes were "capped" with new pondcrete (voids filled) for shipment test program.
  - Five (5) operators received additional training on new processing system.
  - An additional two (2) new operators are receiving training on pondcrete operations.
  - Five (5) shipment test program boxes were returned, opened and sectioned Three (3) were repackaged into new plywood boxes.

- Storage Pad 750
  - Inspections ongoing
  - One (1) box of saltcrete released approximately 40 pounds of dry material to the pad. Spilled material was cleaned up and defective box was shipped to Building 374 for reprocessing.

- Storage Pad 904
  - Inspections ongoing
  - No leaks or spills

- Procedures
  - Packaging and Shipping Solar Pond Sludge (WO-4036); retitled to Processing and Immobilization of Solar Pond Sludge.

- Summary Reports - Attached

SUMMARY REPORT - OCTOBER 12 - NOVEMBER 1, 1988

This report provides a summary of pondcrete activities for the period October 12, 1988 through November 1, 1988 Information is included on the status of the Qualification and Shipment Test Program.

The Qualification and Shipment Test Program consists of two parts, 1) initial qualification of the immobilization process and 2) test shipment of representative packages. Upon completion of process testing, three plywood boxes containing two each old pondcrete blocks were filled with newly cast pondcrete on October 14 for the qualification test. The new waste form compressive strength was measured by penetrometer on October 17 at greater than 9000 psf No liquids were observed when the boxes were tipped on edge on October 18 Inspection of the sides and bottom of the waste form on October 19, after the plywood had been stripped, revealed that there were no free liquids in the poncrete matrix. Testing to ASTM Method D4359-84 "Standard Test Method for Determining Whether a Material is a Liquid or a Solid" was conducted on samples taken from each box and all three were classified as solids. These results indicate that the pondcrete process is acceptable for the shipment test program.

The shipment test program will be conducted using: 1) three plywood boxes containing two each, old pondcrete blocks with the void spaces filled with new pondcrete and 2) two boxes containing two each, old pondcrete blocks without the voids filled. The void spaces in three boxes were filled on October 20 with new pondcrete.

The new pondcrete was tested on October 24 and was found to be acceptable with compressive strengths >9000 psf The ASTM test for liquid/solid determination was run on October 25 and resulted in the samples being classified as solids. Final inspection of the three trial shipment boxes with voids filled and two boxes without voids filled was performed by Traffic and Waste Certification on October 26. The five boxes have been shipped to Building 664 for overpacking and loading into the trailers. The shipment is scheduled for November 7 or November 8, 1988.

SUMMARY REPORT - NOVEMBER 2 - NOVEMBER 17, 1988

This report provides a summary of pondcrete activities for the period November 2, 1988 through November 17, 1988. Information is included on completion of the Qualification and Shipment Test Program

The Qualification and Shipment Test Program was completed on November 17 with positive results Results of the qualification portion of this program were discussed in the November 2, 1988 bi-weekly report The shipment test program was conducted using 1) three plywood boxes each, containing two old pondcrete blocks with the void spaces filled with new pondcrete, and 2) two boxes each, containing two old pondcrete blocks without the voids filled. Preparation for the shipment test, detailed in the previous summary report, included filling of the void spaces, penetrometer testing and solid/liquid determination using ASTM Method D4359-84 "Standard Test Method for Determining Whether a Material is a Liquid or a Solid."

The plywood boxes were placed into metal overpacks, for the test shipment only, and were loaded into the semi-trailers on November 4 1988 After final inspection of the shipment, the trailers were shipped on November 8 from Rocky Flats Plant to the Nevada Test Site and returned to RFP on November 10, 1988. The trailers were opened on November 11 and no evidence of any problem occurring during transportation was apparent. The overpack containers were opened on November 14 and 15 and the outside surface of the plywood containers was found to be in excellent condition.

The plywood boxes were returned to the pondcrete processing facility for opening and visual inspection The boxes were opened and then tipped on edge on November 16 Inspection of the sides and bottom of the waste forms on November 17, after the plywood had been stripped, revealed there were no free liquids in the pondcrete matrix The particulates found are expected to be within criteria limits Only minor amounts of particulate were found with one exception. One of the blocks in a package without the voids filled experienced some crumbling, primarily into large pieces. The crumbling probably occurred as a result of the inspection procedure when the package was tipped on edge then completely over. All particulate less than approximately one inch was separated, collected, and a representative sample was submitted for particle size analysis.

Results of the Qualification and Shipment Test Program will be finalized and are expected to indicate that all packages performed well in transportation over twice the normal shipping distance. The "Pondcrete Repackaging and Reprocessing Plan" is being finalized to allow for shipment of either 4' x 4' x 7' boxes or 2' x 4' x 7' boxes with or without voids filled.

0019 89

Department of Energy

ALBUQUERQUE OPERATIONS
ROCKY FLATS AREA OFFICE
P O BOX 928
GOLDEN COLORADO 80402-0928

DEC 23 1988

Mr David C. Shelton
Director, Hazardous Materials
and Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Dear Mr Shelton:

Transmitted herewith is the monthly status report on the pondcrete operations which were conducted at the U S Department of Energy's Rocky Flats Plant from November 21, 1988 through December 16, 1988.

Questions concerning the content of the report can be directed to Ms. Candice Jierree of my staff at 966-4888.

Sincerely,

Albert E. Whiteman
Area Manager

Enclosure

cc w/encl:
Robert Duprey, EPA
James Wilson, Rocky Flats Monitoring Council
Tod Anderson, RFAO

bcc:
E. R. Naimon, Rockwell
P M Arnold, Rockwell

Received for Addressee
Corres. Control RFP
1/3/89 EA

STATUS REPORT FOR PONDCRETE OPERATIONS (THROUGH DECEMBER 16, 1988)

- Building 788 (processing area)
  - No new pondcrete was produced.
  - Thirty-two (32) acceptable blocks of pondcrete were repackaged into plywood boxes in preparation for the initial shipment to the Nevada Test Site (anticipated during week of December 19).
- Storage Pad 750
  - No leaks or spills
- Storage Pad 904
  - No leaks or spills
  - Approximately 54,000 gallons of precipitation runoff was collected by tanker truck and transported to Building 374 for evaporation.
  - Three (3) protective tarps were retied after loosened by high winds.
- Procedures
  - Procedure, Processing and Immobilization of Solar Pond Sludge (WO-4036), finalized and approved.
- Summary Report - Attached

SUMMARY REPORT - NOVEMBER 21 - DECEMBER 16, 1988

This report provides a summary of pondcrete activities for the period November 21, 1988 through December 16, 1988. Information is included on completion of the final audit by DOE/NV prior to authorization to ship pondcrete.

The final pondcrete audit (corrective action implementation review) was conducted November 29-30, 1988. The review team consisted of Gene Hampton, Gene Kendall (REECo), Mark E. Van Der Puy, Darrell M. Warren (DOE/NV), and Richard Sena (DOE/AL). The purpose of the audit was to verify that the Rocky Flats Plant corrective actions are adequate and implemented in an effective and efficient manner. The representatives were given an overview, summary of the test shipment, and a tour of the processing operation and storage pads.

All applicable documentation such as the operating procedure, inspection procedure, waste packaging procedure, quality assurance plan, traffic procedure and the repackaging and reprocessing plan was presented and discussed to demonstrate compliance with DOT, EPA and DOE regulations and criteria. All issues were resolved and the reviewers recommended to their management final approval of the pondcrete waste form for mixed waste disposal at the Nevada Test Site. Further conversation with the reviewers indicates that the package has been forwarded for final approval to the DOE/NV Assistant Manager for ES&H and the Nevada Operations Manager.

Department of Energy

ALBUQUERQUE OPERATIONS
ROCKY FLATS AREA OFFICE
P.O. BOX [illegible]
GOLDEN, COLORADO [illegible]

FEB 0 2 1989

Mr David C Shelton, Director
Hazardous Materials and Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Dear Mr. Shelton:

Enclosed is the monthly status report for pondcrete operations from December 17, 1988 through January 25, 1989 Included is a copy of the summary report generated in that time period and analytical results of water samples from the storage pads.

If you have any questions regarding the content of this report, please refer them to Ms. Candice Jierree of my staff on 966-4888

Sincerely,

Albert E. Whiteman
Area Manager

Enclosure

cc w/encl
R.L Duprey, EPA
G Dancik, CDH
J Wilson, Env Monitoring. Counsel

STATUS REPORT FOR PONDCRETE OPERATIONS (THROUGH JANUARY 25, 1989)

- Building 788 (processing area)
  - No new pondcrete was produced.
  - Forty-four (44) acceptable blocks of pondcrete were repackaged into twenty-two (22) plywood boxes for subsequent shipment to the Nevada Test Site.

- Storage Pad 750
  - No leaks or spills
  - Ninety-nine (99) unacceptable blocks of pondcrete were overpacked into thirty-three (33) metal boxes and re-stored on the pad.

- Storage Pad 904
  - No leaks or spills
  - Seventy-eight (78) unacceptable blocks of pondcrete were overpacked into twenty-six (26) metal boxes and re-stored on the pad.
  - Approximately 36,000 gallons of precipitation runoff was collected by tanker truck and transported to Building 374 for evaporation.
  - A new articulating forktruck was received which will allow the safe retrieval of stored pondcrete.

- Summary Report - Attached

- Runoff Data - Attached

SUMMARY REPORT - DECEMBER 17 - JANUARY 25, 1989

This report provides a summary of pondcrete activities for the period December 17, 1988 through January 25, 1989 Information is included on the approval to ship and on the initial routine shipment of pondcrete to the Nevada Test Site.

The Department of Energy Nevada Operations Office approved the acceptance of pondcrete for interim storage at the Nevada Test Site, Area 5 Radioactive Waste Management Site. The approval was granted in a letter from Nick C. Aquilina, NV to Bruce G. Twining, AL, dated December 13, 1988, and in a letter, John G. Themelis, AL/EHD to A. E. Whiteman, RFAO, dated December 16, 1988. Requirements outlined in the Aquilina letter, namely arrangements for payment and for scheduling shipment arrivals to the NTS, have been addressed. Payment for storage of three months of expected shipments was forwarded via overnight delivery on December 16, 1988. Notification of shipment arrivals for all waste shipments to NTS is routinely coordinated between the Rockwell and REECo Traffic Departments.

Twelve plywood boxes (2'x4'x7') were prepared for the initial shipment of pondcrete to NTS. Each box contained two old pondcrete blocks which had been inspected and approved. The voids in the boxes contained solidified pondcrete pieces from the qualification and shipment test program. The twelve packages were loaded into two semi-trailers and were shipped from Rocky Flats Plant on December 21, 1988 and arrived at NTS on December 22, 1988. Activities are ongoing to remove, inspect and repackage stored pondcrete blocks from the pads and to routinely ship to NTS.

904 and 750 PONDCRETE STORAGE AREAS MONITORING DATA

Analytical results from analysis of grab samples collected at the 750 and 904 pondcrete storage areas are summarized below.

Table 1
750 Pad Culvert and Puddle Samples

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
9/07/88	1.55	20±22	21±27
9/12/88	5.38	7±18	42±28
9/13/88	5.49	7±11	10±24
9/13/88	4.82	13±16	21±25
9/14/88	3.75	5±16	14±26
9/21/88	1.56	20±15	34±25
9/28/88	1.51	55±28	17±32
10/05/88	1.52	19±25	24±33
10/06/88	9.51	16±13	25±25
10/12/88	1.93	5±8	8±14
10/19/88	1.18	11±13	25±14
10/26/88	1.23	14±12	16±16
11/02/88	1.28	14±13	14±18
11/09/88	2.68	5±12	2±14
11/10/88	4.53	18±19	11±22
11/15/88	1.06	9±12	3±17
11/16/88	0.99	11±24	5±21
11/30/88	1.09	13±14	-2±12

904 and 750 PONDCRETE STORAGE AREAS MONITORING DATA (continued)

Table 2
904 Pad Pondcrete Monitoring Data

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
9/12/88	14.6	10±19	60±33
9/14/88	72.6	47±20	110±40
9/15/88	--	16±12	51±30
9/15/88	--	40±18	50±27
10/06/88	44.3	10±15	77±30
11/10/88	18.8	14±13	51±27
11/15/88	7.61	27±17	16±19

These data were gathered as part of the routine environmental monitoring conducted by the Environmental Management group to screen runoff waters from the pads. It should be noted that these samples may have been taken at either the beginning or end of a precipitation event, with the initial runoff likely containing higher levels of nitrate, alpha and beta.

Department of Energy

ALBUQUERQUE OPERATIONS
ROCKY FLATS AREA OFFICE
P.O. BOX 928
GOLDEN, COLORADO 80402-0928

MAR 0 1 1989

Mr. David Shelton, Director
Hazardous Materials and
Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, CO 80220

Dear Mr. Shelton:

Transmitted herewith is the monthly status report on the pondcrete operations which were conducted at the U. S. Department of Energy's Rocky Flats Plant from January 26, 1989 through February 23, 1989.

Question concerning the content of the report can be Ms. Candice Jierree of my staff at 966-4888.

Sincerely,
Original Signed By
ALBERT E. WHITEMAN

Albert E. Whiteman
Area Manager

Enclosure

cc w/enc:
R. L. Duprey, Dir, Hazardous Mtls
& Waste Mgmt Div, EPA, Region VIII
J. Wilson, Rocky Flats Monitoring Council
G. Dansik, CDH

bcc w/enc:
T. Anderson, RFAO
E. R. Naimon, Rockwell
P. M. Arnold, Rockwell

STATUS REPORT FOR PONDCRETE OPERATIONS (JAN 26 THROUGH FEB 23, 1989)

- Building 788 (processing area)
  - No new pondcrete was produced.
  - One hundred sixty-eight (168) acceptable blocks of pondcrete were repackaged into 84 plywood boxes and shipped to the Nevada Test Site.

- Storage Pad 750
  - No leaks or spills
  - One hundred fifty (150) blocks of pondcrete were removed from the pad for shipment to Building 788, inspection and repackaging into plywood crates for shipment to the Nevada Test Site.

- Storage Pad 904
  - No leaks or spills
  - Nine (9) stacks (72 blocks each) of pondcrete were restacked into stacks 4 x 6 x 2 high. Also, from the 9 stacks, 22 metal crates, holding 3 blocks each, were generated and stored on the pad.
  - Approximately 36,000 gallons of precipitation runoff were collected by tanker truck and transported to Building 374 for evaporation.

- Runoff Data - Attached

904 and 750 PONDCRETE STORAGE AREAS MONITORING DATA

Analytical results from analysis of grab samples collected at the 750 and 904 pondcrete storage areas are summarized below.

Table 1
750 Pad Culvert

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
12/07/88	1.13	28 ± 14	14 ± 18
12/14/88	1.26	8 ± 9	15 ± 13
12/21/88	2.10	11 ± 15	3 ± 18
01/04/89	1.54	2 ± 9	5 ± 13
01/11/89	1.40	6 ± 10	9 ± 14
01/18/89	1.47	23 ± 13	9 ± 13
01/25/89	1.39	49 ± 20	17 ± 14
02/08/89	Source frozen, no sample		

Table 2
750 Pad Puddle

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
12/08/88	3.97	27 ± 13	45 ± 16
01/06/89	2.83	5 ± 8	15 ± 14
01/26/89	4.69	17 ± 11	35 ± 16

904 and 750 PONDCRETE STORAGE AREAS MONITORING DATA (continued)

Table 3
904 Pad Puddle

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
12/08/88	2.77	17 ± 10	41 ± 15
12/16/88	1 20	10 ± 11	36 ± 21
01/06/89	2.25	-1 ± 7	21 ± 14
01/26/89	16.5	13 ± 10	39 ± 16

These data were gathered as part of the routine environmental monitoring conducted by the Environmental Management group to screen runoff waters from the pads. Care must be used in any interpretation of these data; the data are derived from grab samples taken in a dynamic system.

Department of Energy

ALBUQUERQUE OPERATIONS
ROCKY FLATS AREA OFFICE
P.O. BOX 928
GOLDEN, COLORADO 80402-0928

MAR 3 0 1989

Mr David C Shelton, Director
Hazardous Materials and Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Dear Mr. Shelton:

Transmitted herewith is the monthly status report on the pondcrete operations which were conducted at the U S. Department of Energy's Rocky Flats Plant from February 24, 1989 through March 26, 1989.

Questions concerning the content of the report can be directed to Ms Candice Jierree of my staff at 966-4888.

Sincerely,

C-
ALS--

Albert E. Whiteman
Area Manager

Enclosure

cc w/encl:
R.L. Duprey, EPA
G Dancik, CDH
J. Wilson, Env. Monitoring Counsel

STATUS REPORT FOR PONDCRETE OPERATIONS (FEB 24 THROUGH MAR 26, 1989)

- Building 788 (processing area)
  - No new pondcrete was produced.
  - One hundred ninety-six (196) acceptable blocks of pondcrete were repackaged into 98 plywood boxes and shipped to the Nevada Test Site.

- Storage Pad 750
  - No leaks or spills
  - Two hundred eighty-two (282) blocks of pondcrete were removed from the pad for shipment to Building 788, for inspection.

- Storage Pad 904
  - No leaks or spills
  - Forty-four (44) stacks (72 blocks each) of pondcrete were restacked into smaller stacks and metal crates.
  - Approximately 75,000 gallons of precipitation runoff were collected by tanker truck and transported to Building 374 for evaporation.

Department of Energy

ALBUQUERQUE OPERATIONS
ROCKY FLATS AREA OFFICE
P.O. BOX [illegible]
GOLDEN, COLORADO [illegible]

MAY 02 1989

David C. Shelton, Director
Hazardous Materials & Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Dear Mr. Shelton:

Please find enclosed the monthly status report on the Rocky Flats Plant pondcrete operations for the period from March 27, 1989 through April 23, 1989.

Please contact Mark E. Van Der Puy, of my staff, at telephone 966-2473 if you have any questions regarding this report.

Sincerely,

Rush O. Inlow

Rush O. Inlow
Acting Area Manager

Enclsoure

cc w/encl:
R.L. Duprey, EPA, Region VIII
J. Wilson, RF Env Monitoring Council
G. Dansik, CDH

cc w/o encl:
T.W. Anderson, RFAO
E.R. Naimon, Rockwell
P.M. Arnold, Rockwell

STATUS REPORT FOR PONDCRETE OPERATIONS (MAR 27 THROUGH APR 23, 1989)

- Building 788 (processing area)
  - No new pondcrete was produced.
  - Three hundred sixteen (316) acceptable blocks of pondcrete were repackaged into 158 plywood boxes and shipped to the Nevada Test Site.
- Storage Pad 750
  - On April 7, one tri-wall block of saltcrete was found which had broken open and released approximately one pound of material to the pad. Radioactivity measured on the pad did not exceed background.
- Storage Pad 904
  - No leaks or spills
  - Approximately 45,000 gallons of precipitation runoff were collected by tanker truck and transported to Building 374 for evaporation.
  - Runoff Data - Attached

Analytical results from analysis of grab samples collected at the 750 and 904 pondcrete storage areas are summarized below. This report includes all data collected since 1/26/89. The plant guide for nitrate discharges is 10 mg/l; for gross alpha is 40 pCi/l; and for gross beta is 50 pCi/l.

Table 1
750 Pad Culvert

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
2/15/89	1.66	9 ± 12	19 ± 14
2/22/89	5.90	8 ± 10	16 ± 15
3/01/89	3.57	13 ± 12	41 ± 17
3/08/89	5.41	-2 ± 8	1 ± 16
3/15/89	2.55	5 ± 10	16 ± 16
3/22/89	2.79	4 ± 10	5 ± 15

Table 2
750 Pad Puddle Monitoring Data

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
2/24/89	87.4	40 ± 18	95 ± 22
3/08/89	39.2	2 ± 10	38 ± 18
3/21/89	6.13	2 ± 7	5 ± 14

Table 3
904 Pad Monitoring Data

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
2/24/89	27.9	16 ± 14	31 ± 17
3/08/89	46.4	2 ± 10	49 ± 19
3/21/89	16.7	53 ± 18	63 ± 21

These data were gathered as part of the routine environmental monitoring conducted by the Environmental Management group to screen runoff waters from the pads. Care must be used in any interpretation of these data; the data are derived from grab samples taken in a dynamic system.

Rocky Flats Plant
Aerospace Operations
Rockwell International Corporation
P O Box 464
Golden Colorado 80402-0464
(303) 966-7000
Contractor to U S Department of Energy

Rockwell
International

August 30, 1989 89-RF-2996

Edward S. Goldberg
Acting Area Manager, RFO

MONTHLY UPDATE ON STATUS OF PONDCRETE OPERATIONS

This information is for the attention of Candice Jierree.

Attached is a status report for pondcrete operations from July 17, 1989 through August 20, 1989. Upon your approval, please forward the report to the Colorado Department of Health. Copies are also to be provided to EPA and the Rocky Flats Environmental Monitoring Council.

If there are any questions concerning the report, please contact me at 966-7900 or Pat Arnold at 966-2056.

W F. Weston, Director
Plutonium Operations

Orig. and 3 cc - E. S. Goldberg
Enc.

STATUS REPORT FOR PONDCRETE OPERATIONS (JULY 17 THROUGH AUGUST 20, 1989)

- Building 788 (processing area)
  - One (1) block of rejected pondcrete was processed through the remix facility during startup testing. The resulting waste attained an unconfined compressive strength in excess of 9000 pounds per square foot within 24 hours.
  - Four-hundred sixty-four (464) acceptable blocks of pondcrete were repackaged into two-hundred thirty-two (232) plywood boxes for shipment to the Nevada Test Site (NTS).
  - Two-hundred forty (240) plywood crates were shipped to NTS for disposal.

- Storage Pad 750
  - Examination of stored saltcrete is continuing. Eleven (11) boxes of saltcrete were discovered to have leaked approximately fifty (50) pounds of dry material. This material was collected and transferred to Building 374 for processing and the boxes were overpacked into metal crates.

- Storage Pad 904
  - Similar examination efforts have revealed one (1) box of saltcrete which has leaked approximately two (2) pounds of dry material.
  - Approximately 83,000 gallons of precipitation runoff were collected by tanker truck and transported to Building 374 for evaporation.

Department of Energy

ALBUQUERQUE OPERATIONS
ROCKY FLATS AREA OFFICE
P O BOX 928
GOLDEN, COLORADO 80402-0928

AUG 0 2 1989

David C. Shelton, Director
Hazardous Materials & Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Dear Mr. Shelton:

Transmitted herewith is the monthly status report on the pondcrete operations which were conducted at the U S Department of Energy's Rocky Flats Plant from June 26 - July 16, 1989.

Please contact me, or have your staff contact Mark E. Van Der Puy, of my staff, at telephone 966-2473 if you have further questions.

Sincerely,

David P. Simonson
Edward S Goldberg
Acting Area Manager

Enclosure

cc w/encl:
G R. Dancik, CDH
R. Duprey, EPA
J Wilson, RFMC

cc w/o encl:
E.R. Naimon, Rockwell
P.M. Arnold, Rockwell

E.S. CONTROL
OING LTR. NO.

89-RF-2583

DIST.	LTR	ENCL
MCHIN, D.J.	X	X
DER, C.P.		
FURDT, R.J.	X	X
INTZ, E.R.	X	X
OD, R.C.		
KER, E.H.		
NZER, J.E.		
RBY, W.A.		
NETT, J.P.		
EYERS, G.W.		
DECKER, J.H.		
HANNON, W.M.		
ESTON, W.F.	X	X
OZNIAK, B.D.		
OUNG, E.R.		
ETCHER, D.H.		
ARNIVAL, G.J.		
ERRERA, D.W.		
IARMAN, L.K.		
EBERT, J.L.		
OEY, J.B.		
OFFMAN, R.B.		
UHN, R.L.		
D, D.M.	X	X
ENBURG, G.E.		X
AEY, K.B.	X	X
NAIMON, E.R.	X	X
NEWBY, R.L.		
TURNER, H.L.		
VELASQUEZ, R.N.		
CORRES CONTROL	X	X
CONTRACT ADMIN.		
Arnold, P.	X	X
Hulse, E.	X	X
Ivy, D. Lauff	X	X
Peter, K.	X	X
Tallman, D.	X	X
CLASSIFICATION		
UNCLASSIFIED	X	X
CONFIDENTIAL		
SECRET		

AUTH. CLASSIFIER SIG.
J. H. Ramsey
DATE 7/25/89

IN REPLY TO LTR. NO.

cc LWE2.8

APPROVALS
MK

ORIG. & TYPIST INITIALS
RCD/LJ

Rocky Flats Plant
Aerospace Operations
Rockwell International Corporation
P O Box 464
Golden, Colorado 80402-0464
(303) 966-7000
Contractor to U S Department of Energy

Rockwell International

July 25, 1989

89-RF-2583

Edward S. Goldberg
Acting Area Manager, RFO

MONTHLY UPDATE ON STATUS OF PONDCRETE OPERATIONS

This information is for the attention of Candice Jierree.

Attached is a status report for pondcrete operations from June 26, 1989 through July 16, 1989. Upon your approval, please forward the report to the Colorado Department of Health. Copies are also to be provided to EPA and the Rocky Flats Environmental Monitoring Council.

If there are any questions concerning the report, please contact me at 966-7900 or Pat Arnold at 966-2056.

E. R. Naimon, Manager
Waste Operations

Enc. (2)

Orig. and 3 cc - E. S. Goldberg

STATUS REPORT FOR PONDCRETE OPERATIONS (JUNE 26 THROUGH JULY 16, 1989)

- Building 788 (processing area)
  - No new pondcrete was produced.
  - Two-hundred eighty-eight (288) acceptable blocks of pondcrete were repackaged into 144 plywood boxes for shipment to the Nevada Test Site (NTS).
  - One-hundred forty-six (146) plywood crates were shipped to NTS for disposal.

- Storage Pad 750
  - Examination of stored saltcrete is continuing. Two (2) boxes of saltcrete were discovered to have leaked a total of approximately thirteen (13) pounds of dry material. This material was collected and transferred to Building 374 for processing and the boxes were overpacked into metal crates.

- Storage Pad 904
  - Similar examination efforts have revealed two (2) boxes of saltcrete which have leaked a total of eleven (11) pounds of dry material.
  - Approximately 15,000 gallons of precipitation runoff were collected by tanker truck and transported to Building 374 for evaporation.

- Other
  - Modifications to the remix facility are nearly complete with startup testing to follow immediately thereafter.

Analytical results from analysis of grab samples collected at the 750 and 904 pondcrete storage areas are summarized below. This report includes all data collected since 05/09/89. The plant guide for nitrate discharges is 10 mg/l; for gross alpha is 40 pCi/l; and for gross beta is 50 pCi/l.

Table 1
750 Pad Culvert

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
5/17/89	2.48	12 ± 12	7 ± 15
5/24/89	2.38	6 ± 9	32 ± 20
5/31/89	2.25	7 ± 11	26 ± 22
6/07/89	1.23	16 ± 12	-2 ± 16

Table 2
750 Pad Puddle Monitoring Data

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
5/09/89	3.54	19 ± 15	49 ± 22
5/14/89	2.63	28 ± 17	3 ± 8
5/16/89	4.08	6 ± 11	13 ± 18
5/26/89	2.54	24 ± 15	11 ± 15
5/30/89	3.81	14 ± 13	31 ± 20
5/31/89	1.79	-1 ± 8	11 ± 18
6/05/89	28.7	15 ± 15	39 ± 21
6/22/89	2.12	24 ± 16	33 ± 16

Table 3
904 Pad Monitoring Data

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
5/09/89	6.89	21 ± 17	69 ± 23
5/14/89	3.89	23 ± 15	12 ± 13
5/16/89	2.22	11 ± 12	8 ± 17
5/26/89	2.48	7 ± 10	21 ± 16
5/30/89	6.41	16 ± 14	43 ± 22
5/31/89	1.93	13 ± 13	36 ± 22
6/05/89	32.1	15 ± 14	57 ± 24
6/22/89	24.7	20 ± 15	100 ± 30

These data were gathered as part of the routine environmental monitoring conducted by the Environmental Management group to screen runoff waters from the pads. Care must be used in any interpretation of these data; the data are derived from grab samples taken in a dynamic system.

Department of Energy

ALBUQUERQUE OPERATIONS
ROCKY FLATS AREA OFFICE
P O BOX 928
GOLDEN, COLORADO 80402-0928

David C Shelton, Director
Hazardous Materials & Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Dear Mr. Shelton:

Transmitted herewith is the monthly status report on the pondcrete operations which were conducted at the U S Department of Energy's Rocky Flats Plant from May 22, 1989 through June 25, 1989 As discussed with Mr Fred Dowsett, of your staff, leakages associated with saltcrete container failures are included in this report. Future leakages will be similarly reported

Questions concerning the content of the report can be directed to Mark E. Van Der Puy, of my staff, at telephone 966-2473

Sincerely,

for Edward S Goldberg
Acting Area Manager

Enclosure

cc w/encl.
G R. Dancik, CDH
R. Duprey, EPA
J. Wilson, RFMC

cc w/o encl:
E.R. Naimon, Rockwell
P.M. Arnold, Rockwell

S. CONTROL
ONG LTR NO.

89-RF-2196

DIST	LTR	ENCL
NCHINI D J	X	X
DER C P		
FURDT A J	X	X
INTZ E R	X	X
OOD R C		
EKER E H		
NZER J E		
ABY W A		
CNETT J F		
EVERS G W		
ECKER J H		
HANNON W M		
ITH R E		
ESTON W F	X	X
OZNIAK B D		
OUNG E R		
ETCHER D M		
ARNIVAL G J		
ERRERA D W		
ARMAN L K		
EBERT J L		
JB		
MAN R B		
ANN R L		
DM	X	X
UDENBURG G E		
CKINLEY K B	X	X
AIMON E R	X	X
EWBY R L		
TURNER M L		
ELASQUEZ R N		
ORRES CONTROL		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
[illegible]		
LASSIFICATION		
NCLASSIFIED	X	X
ONFIDENTIAL		
ECRET		

AUTH CLASSIFIER SIG

[illegible]

ATE

IN REPLY TO LTR NO

WE 2 8

PPROVALS

ORIG & TYPIST INITIALS

VLA/1.

Rocky Flats Plant
Aerospace Operations
Rockwell International Corporation
P O Box 464
Golden Colorado 80402-0464
(303) 966-7000
Contractor to U S Department of Energy

Rockwell International

June 26, 1989

89-RF-2196

Edward S. Goldberg
Acting Area Manager
DOE, RFAO

MONTHLY UPDATE ON STATUS OF PONDCRETE OPERATIONS

This information is for the attention of Candice Jierree.

Attached is a status report for pondcrete operations from May 22, 1989 through June 25, 1989. Upon your approval, please forward the report to the Colorado Department of Health. Copies are also to be provided to EPA and the Rocky Flats Environmental Monitoring Council.

If there are any questions concerning the report, please contact me at 966-7900 or Pat Arnold at 966-2056.

E. R. Naimon

E. R. Naimon, Manager
Waste Operations

Enc. (2)

Orig. and 3 cc - E. S. Goldberg

STATUS REPORT FOR PONDCRETE OPERATIONS (MAY 22 THROUGH JUNE 25, 1989)

- Building 788 (processing area)
  - No new pondcrete was produced.
  - One hundred eighty-eight (188) acceptable blocks of pondcrete were repackaged into 94 plywood boxes for shipment to the Nevada Test Site (NTS).
  - Eighty-four (84) plywood crates were shipped to NTS for disposal.

- Storage Pad 750
  - All of the stored saltcrete is being carefully examined for breached containers which will be repackaged or repaired to minimize further degradation. As a result, nine (9) boxes of stored saltcrete were discovered to have leaked a total of approximately 7.5 pounds of dry material.

- Storage Pad 904
  - No leaks or spills.
  - Approximately 132,000 gallons of precipitation runoff were collected by tanker truck and transported to Building 374 for evaporation.

- Other
  - The reprocessing mixer is in place, with additional modifications to be installed by July. Draft procedures are being prepared.

Department of Energy

ALBUQUERQUE OPERATIONS
ROCKY FLATS AREA OFFICE
P O BOX 928
GOLDEN COLORADO 80402-0928

JUN 0 1 1989

David C Shelton, Director
Hazardous Materials & Waste Management Division
Colorado Department of Health
4210 East 11th Avenue
Denver, Colorado 80220

Dear Mr. Shelton:

Transmitted herewith is the monthly status report on the pondcrete operations which were conducted at the U S Department of Energy's Rocky Flats Plant from April 24, 1989 through May 21, 1989.

Questions concerning the content of the report can be directed to Mark E. Van Der Puy, of my staff, at telephone 966-2473.

Sincerely,

Rush O. Inlow

Rush O Inlow
Acting Area Manager

Enclosure

cc w/encl:
G R. Dancik, CDH
R Duprey, EPA
J. Wilson, RFMC

cc w/o encl:
T. Anderson, RFAO
E R. Naimon, Rockwell
P.M. Arnold, Rockwell

Rocky Flats Plant
Aerospace Operations
Rockwell International Corporation
P O Box 464
Golden Colorado 80402 0464
(303) 966-7000
Contractor to U S Department of Energy

Rockwell International

May 30, 1989 89-RF-1895

Rush O. Inlow
Acting Area Manager
DOE, RFAO

MONTHLY UPDATE ON STATUS OF PONDCRETE OPERATIONS

This information is for the attention of Candice Jierree.

Attached is a status report for pondcrete operations from April 24, 1989 through May 21, 1989 Upon your approval, please forward the report to the Colorado Department of Health. Copies are also to be provided to EPA and the Rocky Flats Environmental Monitoring Council.

If there are any questions concerning the report, please contact me at 966-7900 or Pat Arnold at 966-2056.

E. R. Naimon, Manager
Waste Operations

Enc. (1)

Orig. and 3 cc - R. O. Inlow

STATUS REPORT FOR PONDCRETE OPERATIONS (APR 24 THROUGH MAY 21, 1989)

- o Building 788 (processing area)
  - No new pondcrete was produced.
  - Three hundred thirty-six (336) acceptable blocks of pondcrete were repackaged into 168 plywood boxes and shipped to the Nevada Test Site.
- o Storage Pad 750
  - No leaks or spills.
- o Storage Pad 904
  - No leaks or spills.
  - Approximately 157,000 gallons of precipitation runoff were collected by tanker truck and transported to Building 374 for evaporation
- o Other
  - Construction activities have begun on the reprocessing facility. The reprocessing scheme involves placing unacceptable pondcrete into a 4.5 cubic yard mixer with Portland cement.

Analytical results from analysis of grab samples collected at the 750 and 904 pondcrete storage areas are summarized below. This report includes all data collected for the period March 29, 1989 to May 10, 1989. The plant guide for nitrate discharges is 10 mg/l; for gross alpha is 40 pCi/l; and for gross beta is 50 pCi/l.

Table 1
750 Pad Culvert

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
3/29/89	2.24	17 ± 14	11 ± 16
4/05/89	2.05	7 ± 10	18 ± 16
4/12/89	2.44	5 ± 9	2 ± 16
4/19/89	2.39	-2 ± 12	2 ± 14
4/26/89	2.17	5 ± 12	13 ± 22
5/03/89	1.29	9 ± 12	11 ± 23
5/10/89	2.37	6 ± 11	27 ± 22

Table 2
750 Pad Puddle Monitoring Data

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
4/11/89	2.88	-2 ± 6	1 ± 14
4/11/89	2.76	11 ± 10	14 ± 16
5/01/89	3.47	7 ± 11	25 ± 22

Table 3
904 Pad Monitoring Data

Sample Date	Nitrate mg/l	Gross Alpha pCi/g	Gross Beta pCi/g
4/11/89	9.6	5 ± 9	22 ± 16
4/11/89	10.5	11 ± 11	27 ± 17
5/01/89	5.02	5 ± 12	44 ± 25

These data were gathered as part of the routine environmental monitoring conducted by the Environmental Management group to screen runoff waters from the pads. Care must be used in any interpretation of these data; the data are derived from grab samples taken in a dynamic system.

Internal Letter

Rockwell International

Date: September 18, 1989

No: LMC.LAD

TO (Name Organization Internal Address)
K. G. Peter
Waste Processing
Bldg 776

FROM (Name Organization Internal Address Phone)
L. A. Dunstan
Environmental Management
Bldg 250
Ext. 5603

SUBJECT: 904 AND 750 PONDCRETE STORAGE AREAS

Analytical results from analysis of grab samples collected at the 750 and 904 pondcrete storage areas are summarized below. This report includes all data collected since 06/15/89. The plant guide for nitrate discharges is 10 mg/l; for gross alpha is 40 pCi/l; and for gross beta is 50 pCi/l.

Table 1
750 Pad Culvert

Sample Date	Nitrate mg/l	Gross Alpha pCi/l	Gross Beta pCi/l
06/15/89	2 75	9 ± 14	19 ± 21
06/21/89	2.44	4 ± 11	-6 ± 14
06/28/89	1 90	9 ± 12	-6 ± 18
07/05/89	1.60	10 ± 13	14 ± 19
07/12/89	1 53	11 ± 13	25 ± 18
07/19/89	1.46	11 ± 10	21 ± 19
07/26/89	1.35	8 ± 12	6 ± 16
08/02/89	1 85	26 ± 15	15 ± 17
08/09/89	1.75	6 ± 10	1 ± 15
08/16/89	1 87	11 ± 13	14 ± 16
08/23/89	2 29	23 ± 14	19 ± 21

Table 2
750 Pad Puddle Monitoring Data

Sample Date	Nitrate mg/l	Gross Alpha pCi/l	Gross Beta pCi/l
07/12/89	6.34	2 ± 10	19 ± 18
07/31/89	3.84	4 ± 8	27 ± 16
08/07/89	3.76	6 ± 10	13 ± 15
08/08/89	3.77	39 ± 16	26 ± 17

Table 3
904 Pad Monitoring Data

Sample Date	Nitrate mg/l	Gross Alpha pCi/l	Gross Beta pCi/l
07/01/89	7.68	18 ± 16	40 ± 21
08/01/89	26.1	11 ± 11	43 ± 18
08/07/89	13 0	27 ± 13	49 ± 19
08/08/89	9 74	20 ± 12	20 ± 17

These data were gathered as part of the routine environmental monitoring conducted by the Environmental Management group to screen runoff waters from the pads Care must be used in any interpretation of these data, the data are derived from grab samples taken in a dynamic system

If you have any questions please call me at extension 5603

L. A. Dunstan

L A Dunstan
Environmental Management

cc: F. D. Hobbs
A. L. Schubert
G. H. Setlock
C. L. Sundblad
R. H. Zuck

APPENDIX E

PAD 904 RUNOFF DATA

904 Pad Puddle Data Sorted by Gross Alpha Activity

Sample Date	Alpha pCi/l	Alpha Error		
6/10/88	-4	17		
6/15/88	-3	18		
1/6/89	-1	7		
2/1/89	-1	6		
3/3/88	0	38		
3/8/89	2	10		
8/17/88	4	9		
4/11/89	5	9		
5/1/89	5	12		
Observations	9	Totals	9 Cum. % =	21.3
6/22/88	6	7		
7/19/88	7	10		
5/26/89	7	10		
9/12/88	10	19		
10/6/88	10	15		
12/16/88	10	11		
Observations	6	Totals	15 Cum. % =	36.3
2/12/88	11	15		
4/11/89	11	11		
5/16/89	11	12		
8/1/89	11	11		
1/31/89	12	10		
1/26/89	13	10		
5/31/89	13	13		
11/10/88	14	13		
6/5/89	15	14		
Observations	9	Totals	24 Cum. % =	58.8
9/15/88	16	12		
2/24/89	16	14		
5/30/89	16	14		
12/8/88	17	10		
7/1/89	18	16		
6/22/89	20	15		
8/8/89	20	12		
Observations	7	Totals	31 Cum. % =	76.3
5/9/89	21	17		
5/14/89	23	15		
Observations	2	Totals	33 Cum. % =	81.3
11/15/88	27	17		
8/7/89	27	13		
6/6/88	29	36		
Observations	3	Totals	36 Cum. % =	88.8

904 Pad Puddle Data Sorted by Gross Alpha Activity

Sample Date	Alpha pCi/l	Alpha Error			
7/22/88	32	26			
Observations	1	Totals	37	Cum. % =	91.3
9/15/88	40	18			
Observations	1	Totals	38	Cum. % =	93.8
9/14/88	47	20			
Observations	1	Totals	39	Cum. % =	96.3
3/21/89	53	18			
Observations	1	Totals	40	Cum. % =	98.8

904 Pad Puddle Data Sorted by Gross Beta Activity

Sample Date	Beta pCi/l	Beta Error		
3/3/88	0	47		
8/17/88	3	23		
2/1/89	3	13		
5/16/89	8	17		
5/14/89	12	13		
11/15/88	16	19		
8/8/89	20	17		
Observations	7	Totals	7 Cum. % =	16.3
1/6/89	21	14		
5/26/89	21	16		
4/11/89	22	16		
4/11/89	27	17		
2/24/89	31	17		
1/31/89	35	15		
12/16/88	36	21		
5/31/89	36	22		
1/26/89	39	16		
7/1/89	40	21		
Observations	10	Totals	17 Cum. % =	41.3
12/8/88	41	15		
5/30/89	43	22		
8/1/89	43	18		
2/12/88	44	27		
5/1/89	44	25		
7/22/88	47	49		
3/8/89	49	19		
8/7/89	49	19		
9/15/88	50	27		
9/15/88	51	30		
11/10/88	51	27		
6/10/88	52	46		
6/22/88	57	14		
6/5/89	57	24		
6/15/88	59	46		
9/12/88	60	33		
Observations	13	Totals	33 Cum. % =	81.3
3/21/89	63	21		
5/9/89	69	23		
7/19/88	70	27		
10/6/88	77	30		
Observations	4	Totals	37 Cum. % =	91.3

904 Pad Puddle Data Sorted by Gross Beta Activity

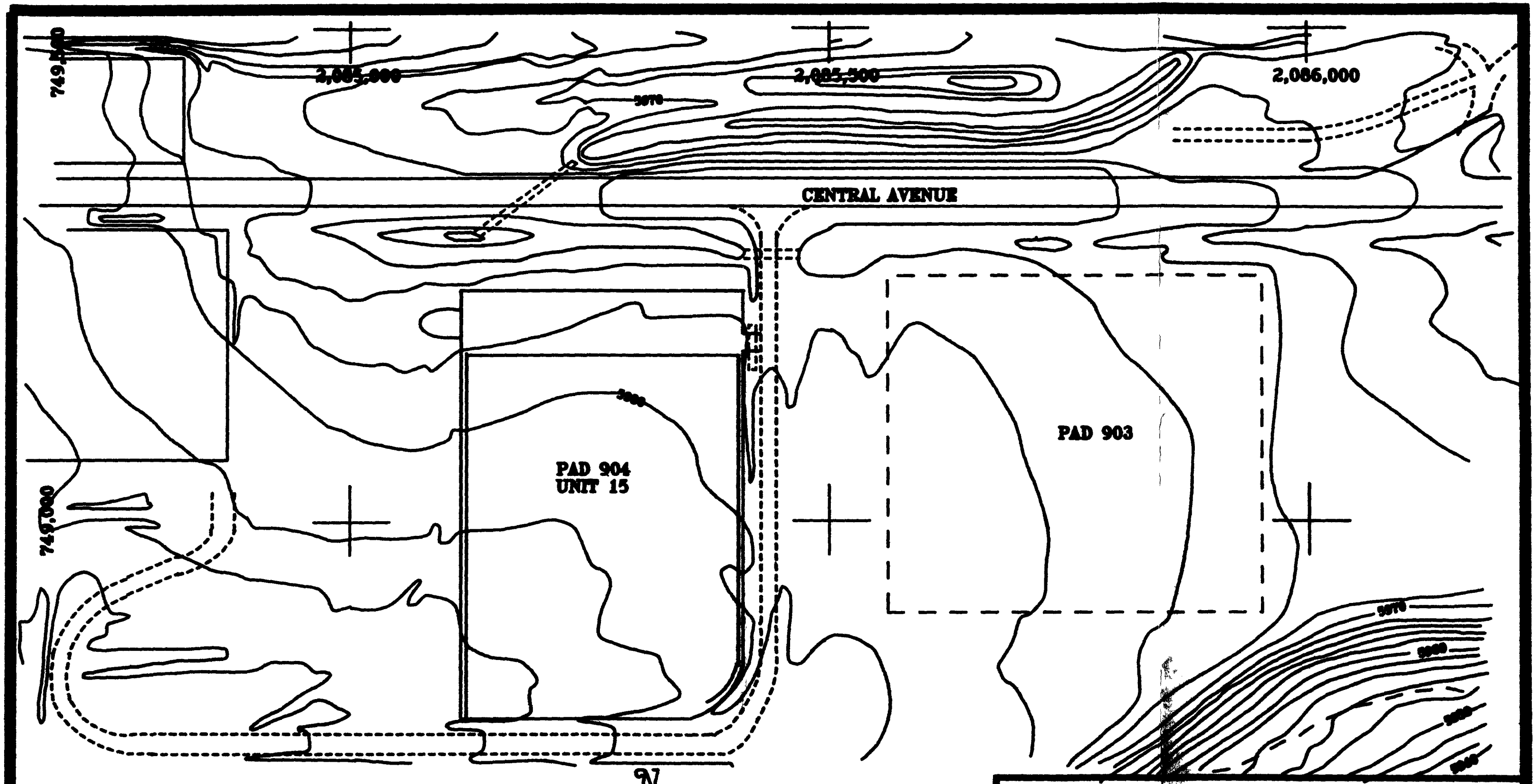
Sample Date	Beta pCi/l	Beta Error		
6/22/89	100	30		
9/14/88	110	40		
Observations	2	Totals	39 Cum. % =	96.3
6/6/88	150	60		
Observations	1	Totals	40 Cum. % =	98.8

904 Pad Puddle Data Sorted by Nitrate Concentrations

Sample Date	Nitrate mg/l			
2/12/88	.08			
12/16/88	1.20			
5/31/89	1.93			
5/16/89	2.22			
3/3/88	2.25			
1/6/89	2.25			
5/26/89	2.48			
12/8/88	2.77			
7/19/88	2.97			
2/1/89	3.20			
5/14/89	3.89			
1/31/89	4.93			
5/1/89	5.02			
5/30/89	6.41			
5/30/89	6.48			
5/9/89	6.89			
11/15/88	7.61			
7/1/89	7.68			
4/11/89	9.60			
6/22/88	9.64			
8/8/89	9.74			
Observations	21	Totals	21 Cum. % =	53.9
4/11/89	10.5			
8/7/89	13.0			
6/15/88	13.1			
9/12/88	14.6			
1/26/89	16.5			
3/21/89	16.7			
11/10/88	18.8			
Observations	7	Totals	28 Cum. % =	72.4
6/22/89	24.7			
8/1/89	26.1			
6/10/88	26.3			
2/24/89	27.9			
Observations	4	Totals	32 Cum. % =	82.9
6/5/89	32.1			
Observations	1	Totals	33 Cum. % =	85.5
10/6/88	44.3			
3/8/89	46.4			
Observations	2	Totals	35 Cum. % =	90.8

904 Pad Puddle Data Sorted by Nitrate Concentrations

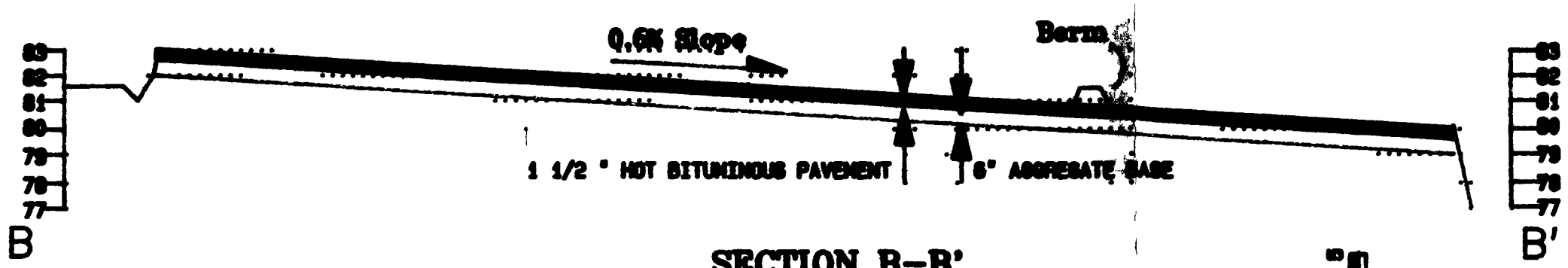
Sample Date	Nitrate mg/l			
9/14/88	72.6			
Observations	1	Totals	36 Cum. % =	93.4
6/6/88	120			
Observations	1	Totals	37 Cum. % =	96.1
6/6/88	178			
Observations	1	Totals	38 Cum. % =	98.7



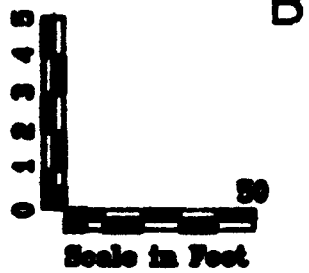
PAD 904 – LOCATION MAP

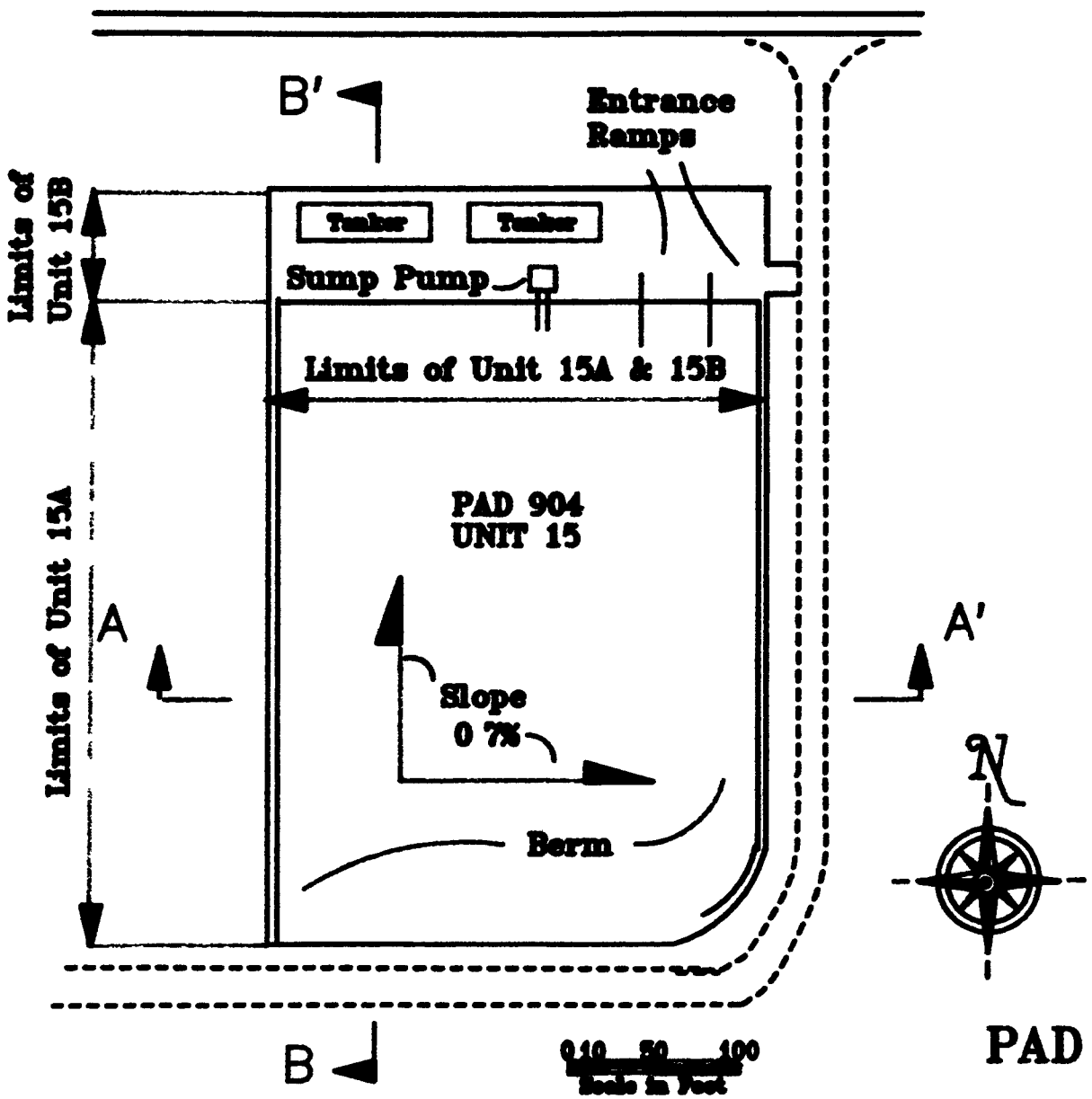
PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

FIGURE 3

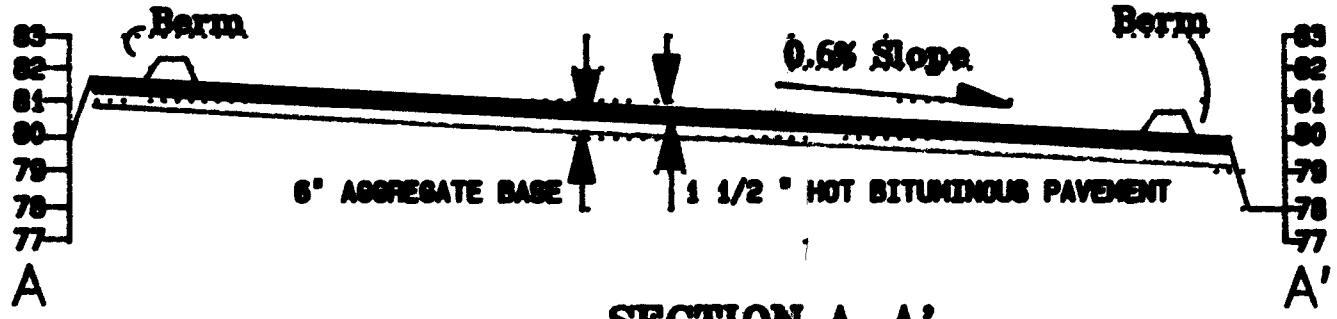


SECTION B–B'
SOUTH TO NORTH CROSS–SECTION OF PAD 904

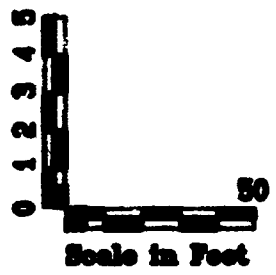




PAD 904 – DETAIL

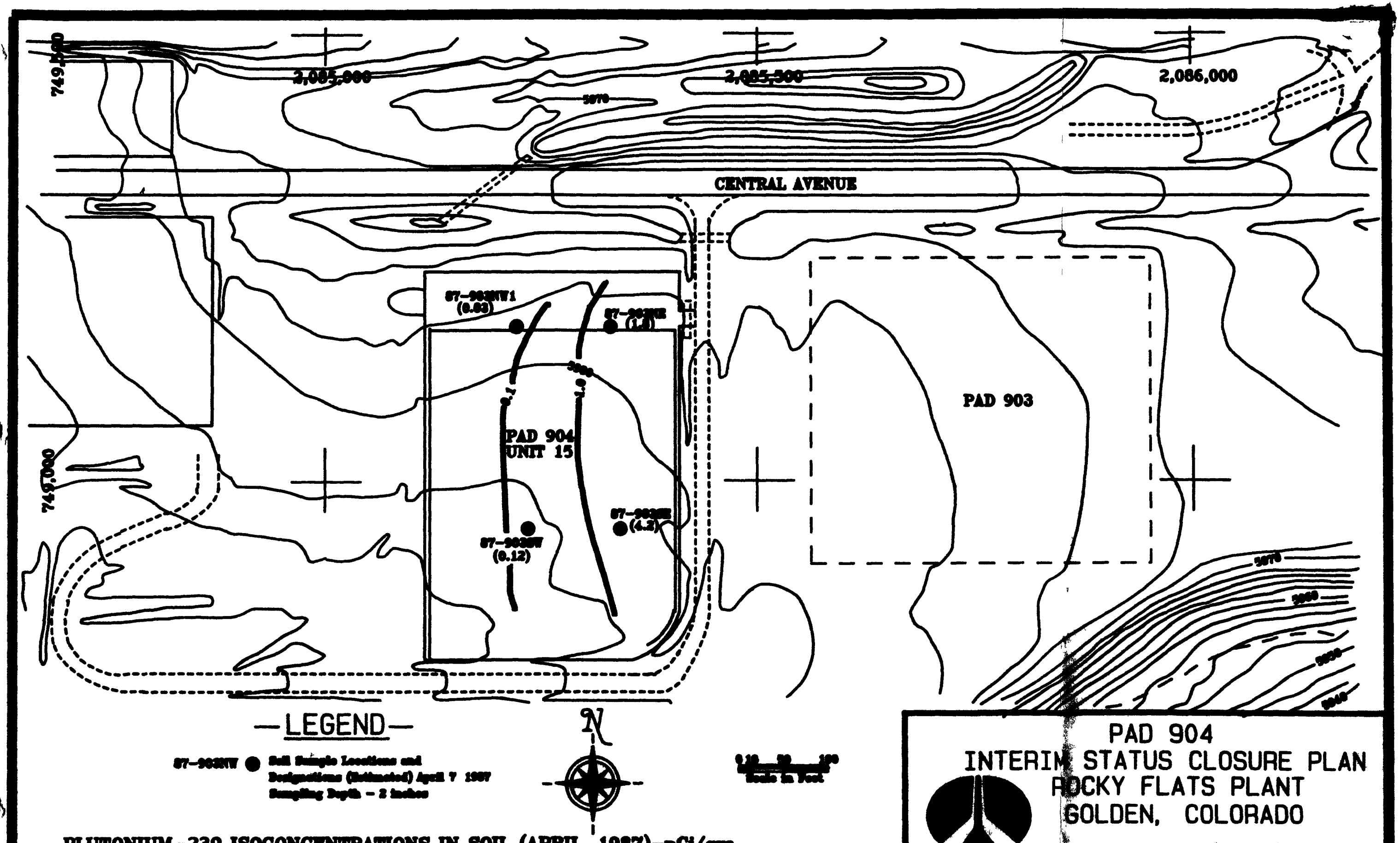


SECTION A–A'
WEST TO EAST CROSS–SECTION OF PAD 904



PAD 904
INTERIM STATUS CLOSUE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

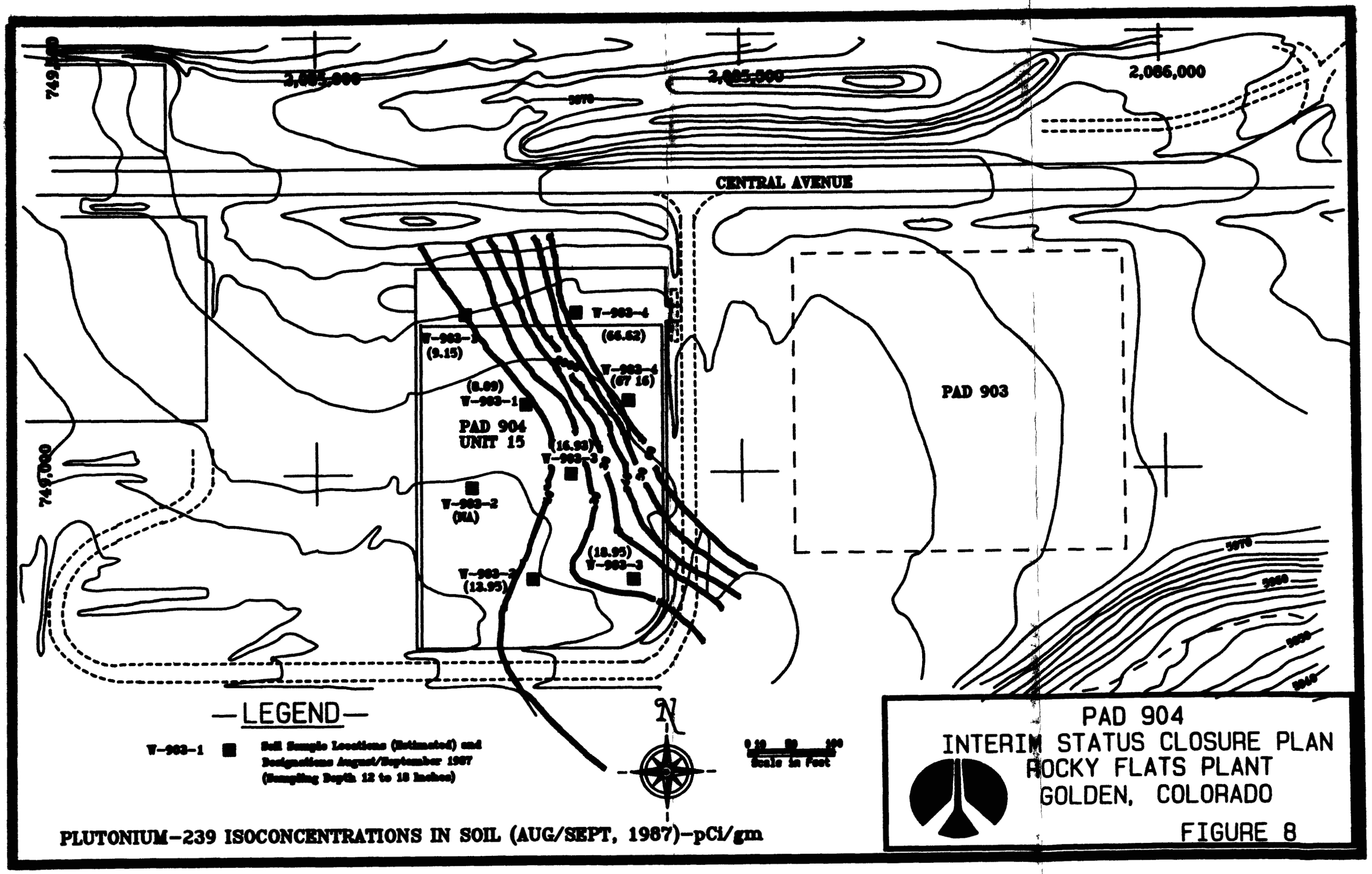
FIGURE 4



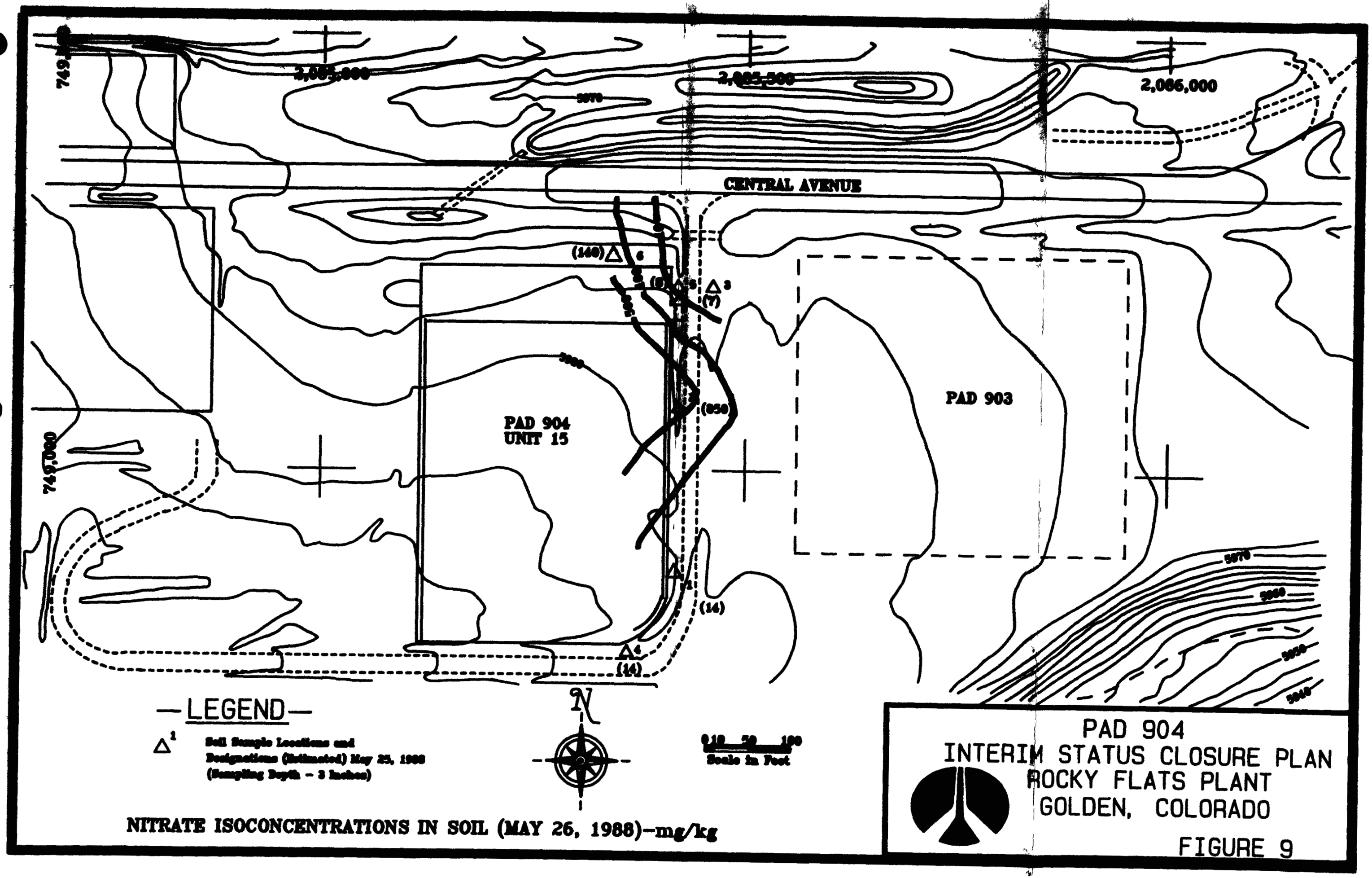
PLUTONIUM-239 ISOCONCENTRATIONS IN SOIL (APRIL, 1987)-pCi/gm

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

FIGURE 7



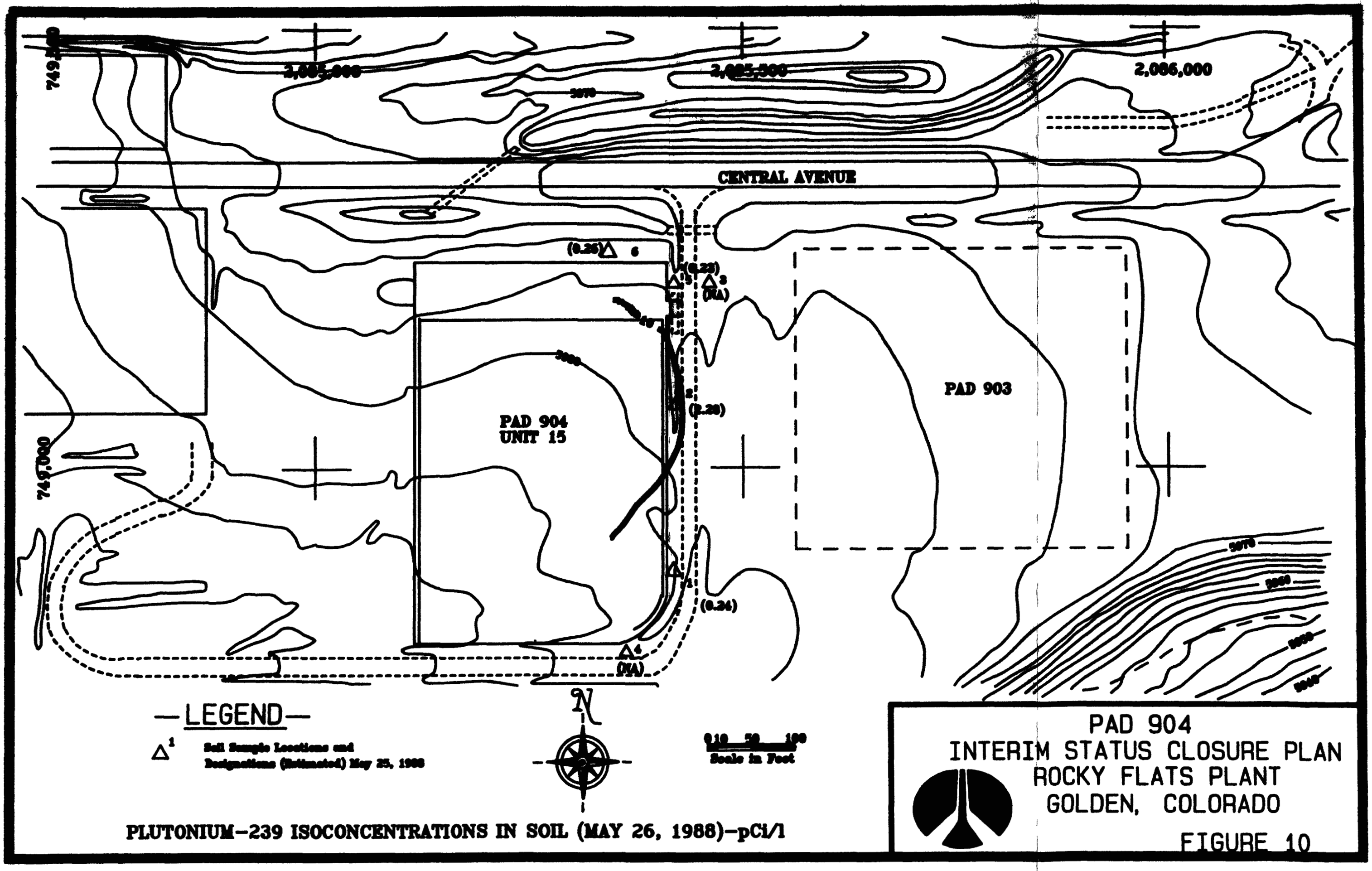
PLUTONIUM-239 ISOCONCENTRATIONS IN SOIL (AUG/SEPT, 1987)-pCi/gm



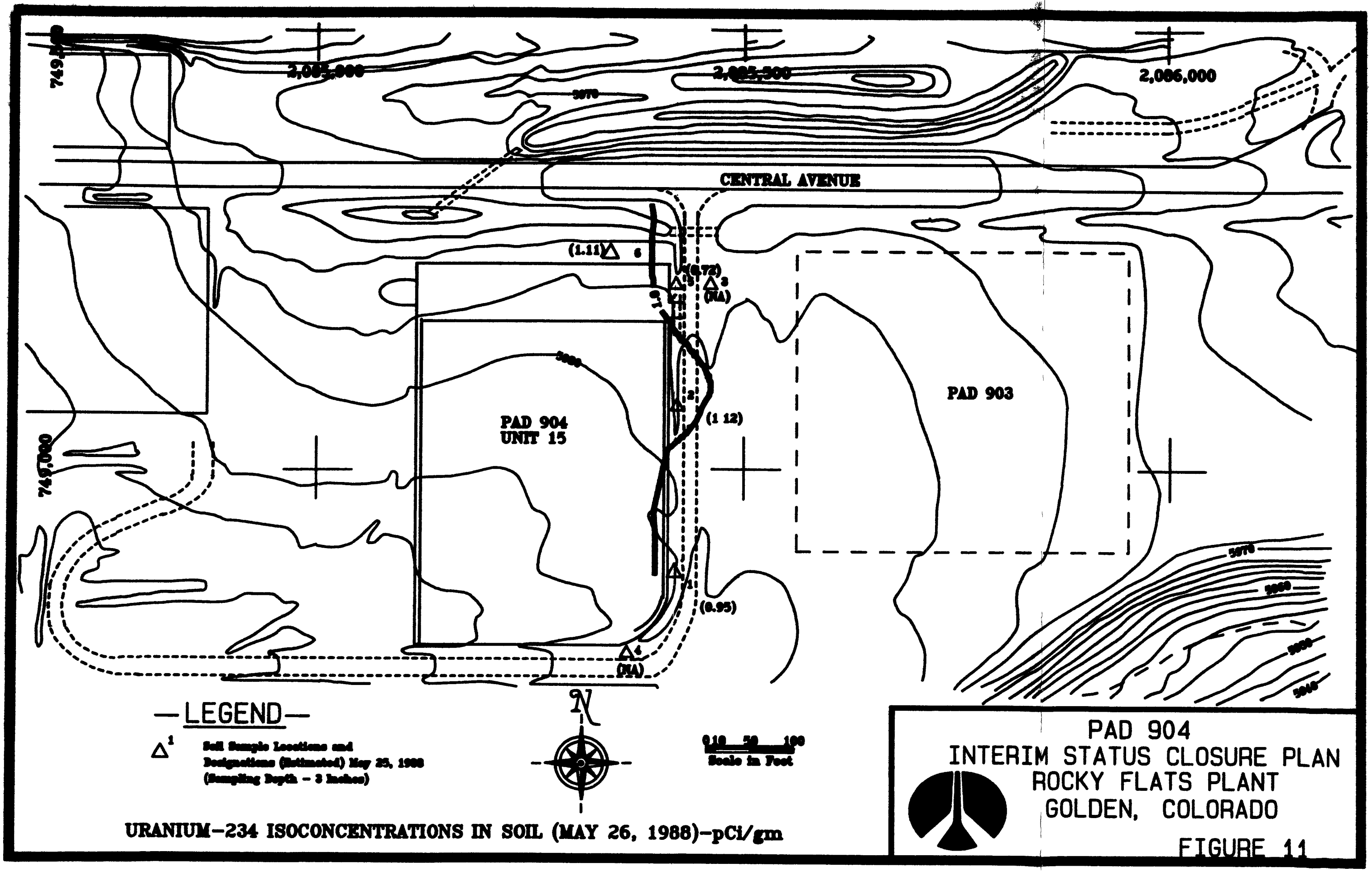
NITRATE ISOCONCENTRATIONS IN SOIL (MAY 26, 1988)—mg/kg

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

FIGURE 9



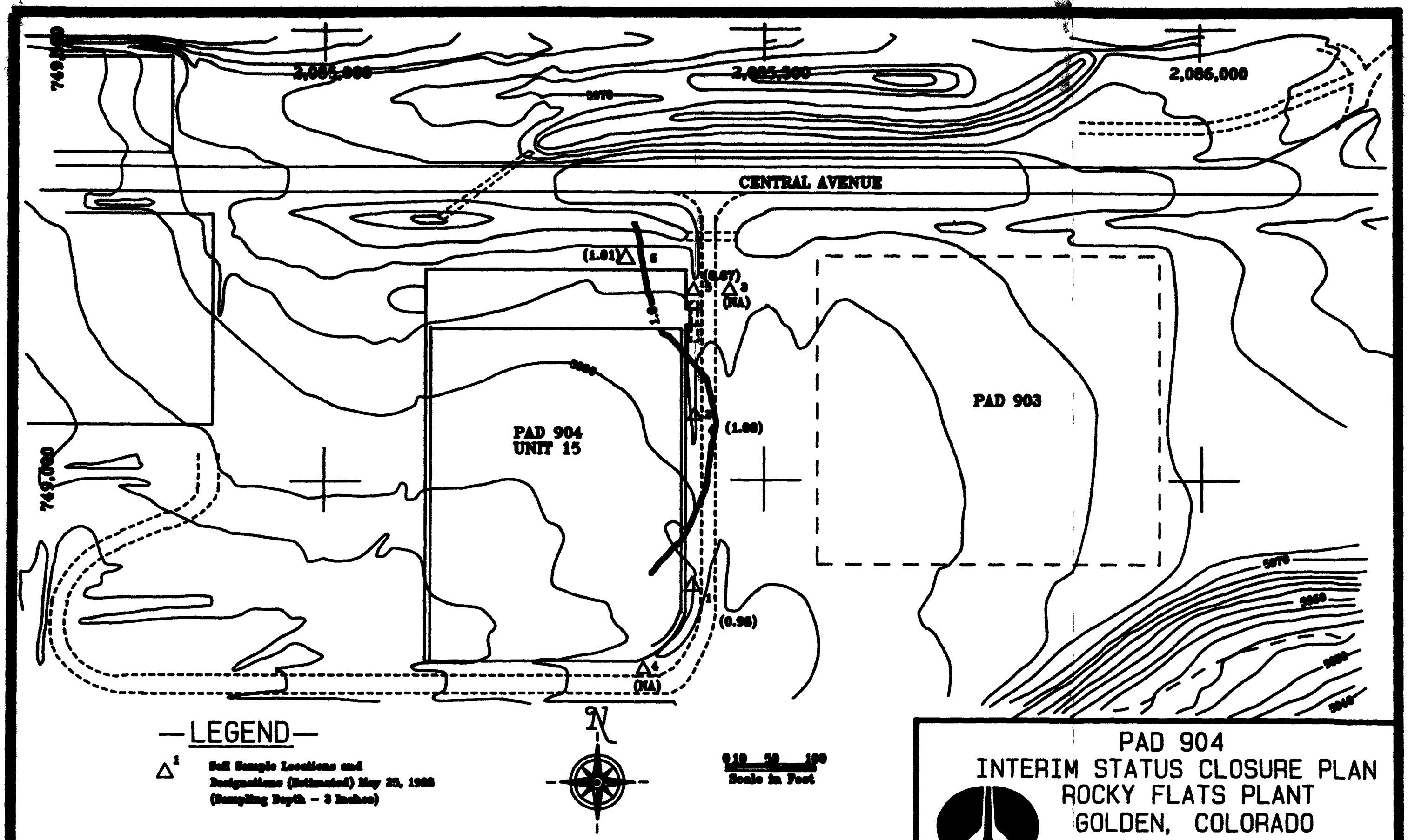
PLUTONIUM-239 ISOCONCENTRATIONS IN SOIL (MAY 26, 1988)-pCi/l



URANIUM–234 ISOCONCENTRATIONS IN SOIL (MAY 26, 1988)–pCi/gm

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

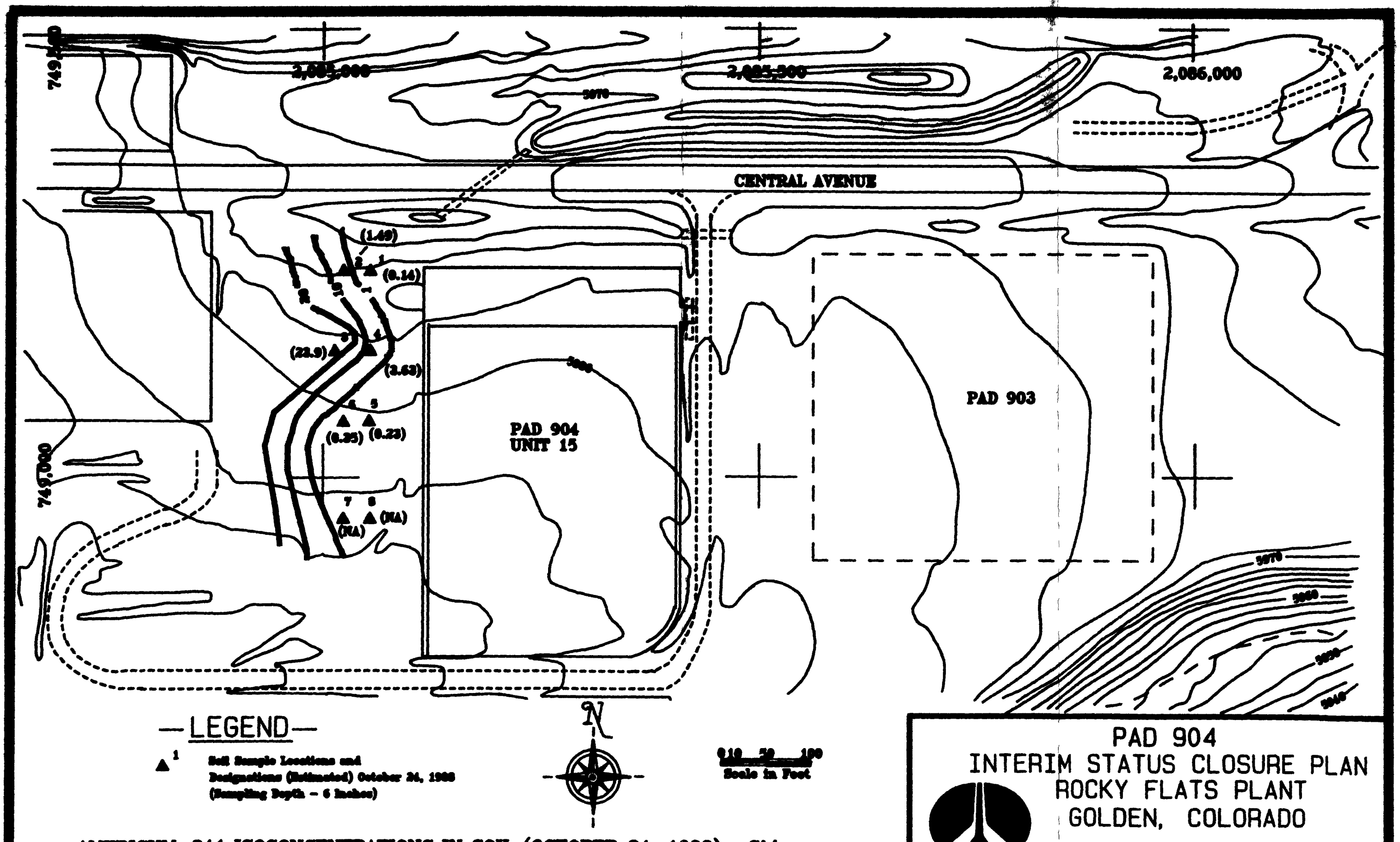
FIGURE 11



URANIUM-238 ISOCONCENTRATIONS IN SOIL (MAY 26, 1988)-pCi/gm

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

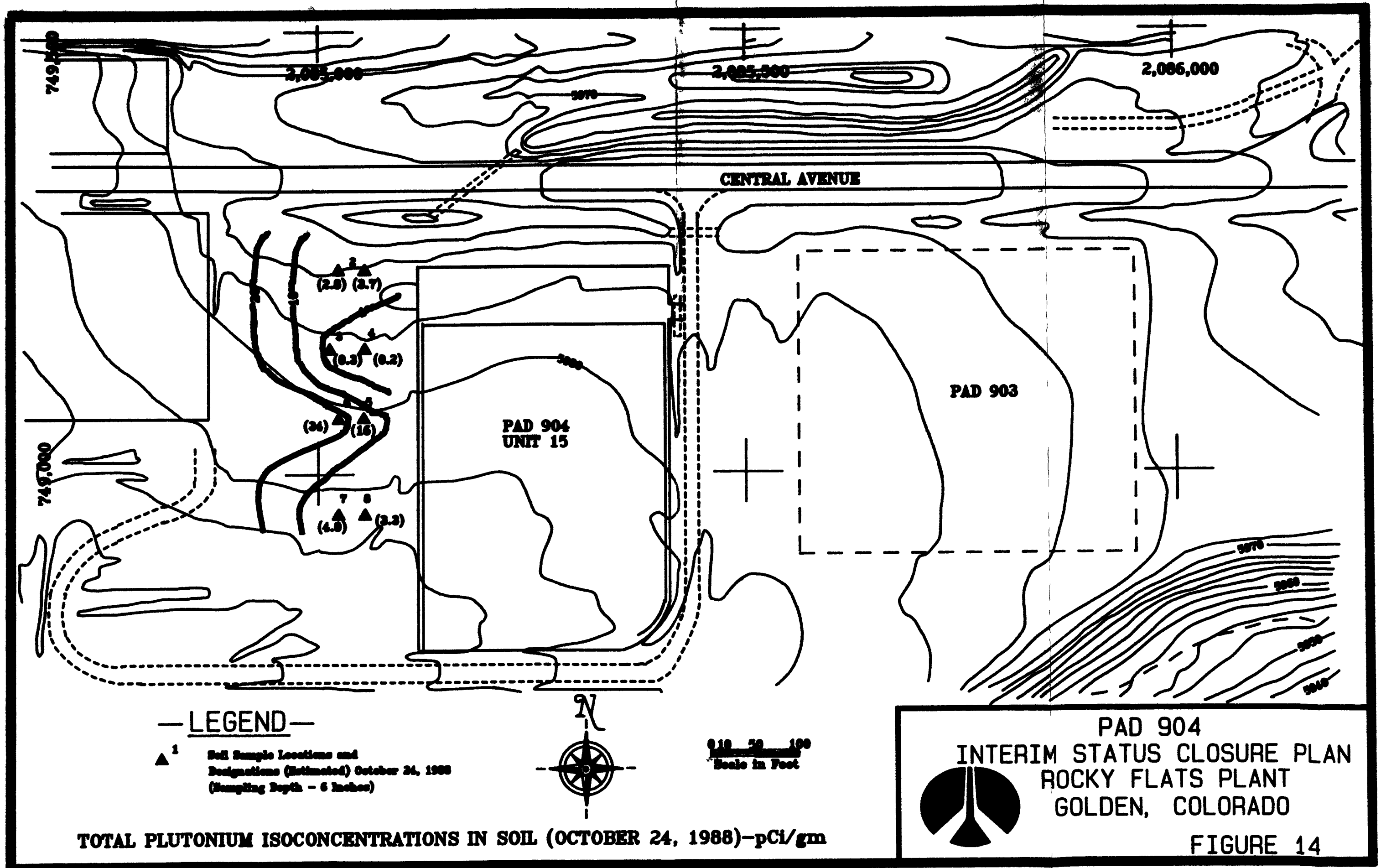
FIGURE 12



AMERICUM-241 ISOCONCENTRATIONS IN SOIL (OCTOBER 24, 1988)-pCi/gm

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

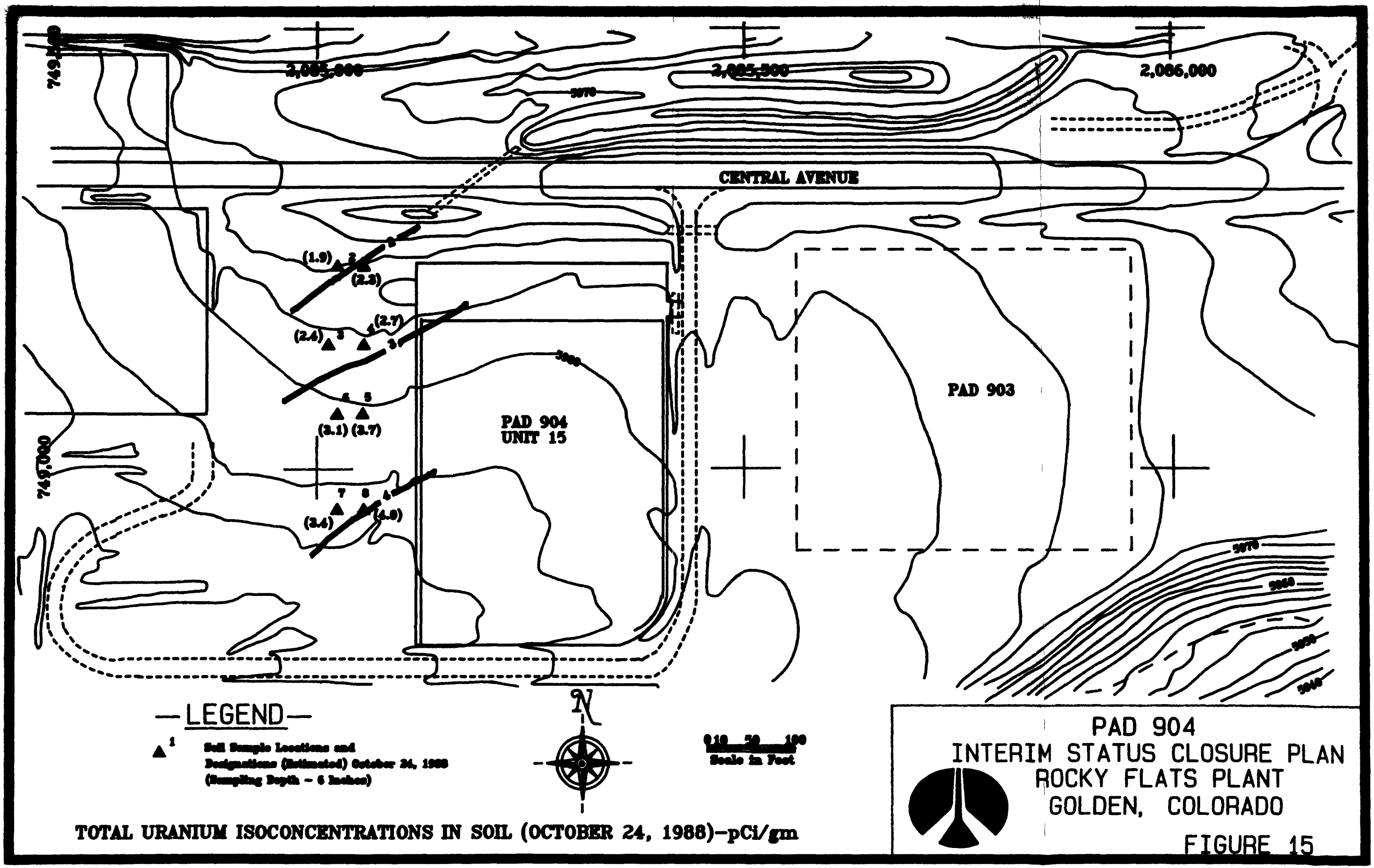
FIGURE 13



TOTAL PLUTONIUM ISOCONCENTRATIONS IN SOIL (OCTOBER 24, 1988)–pCi/gm

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

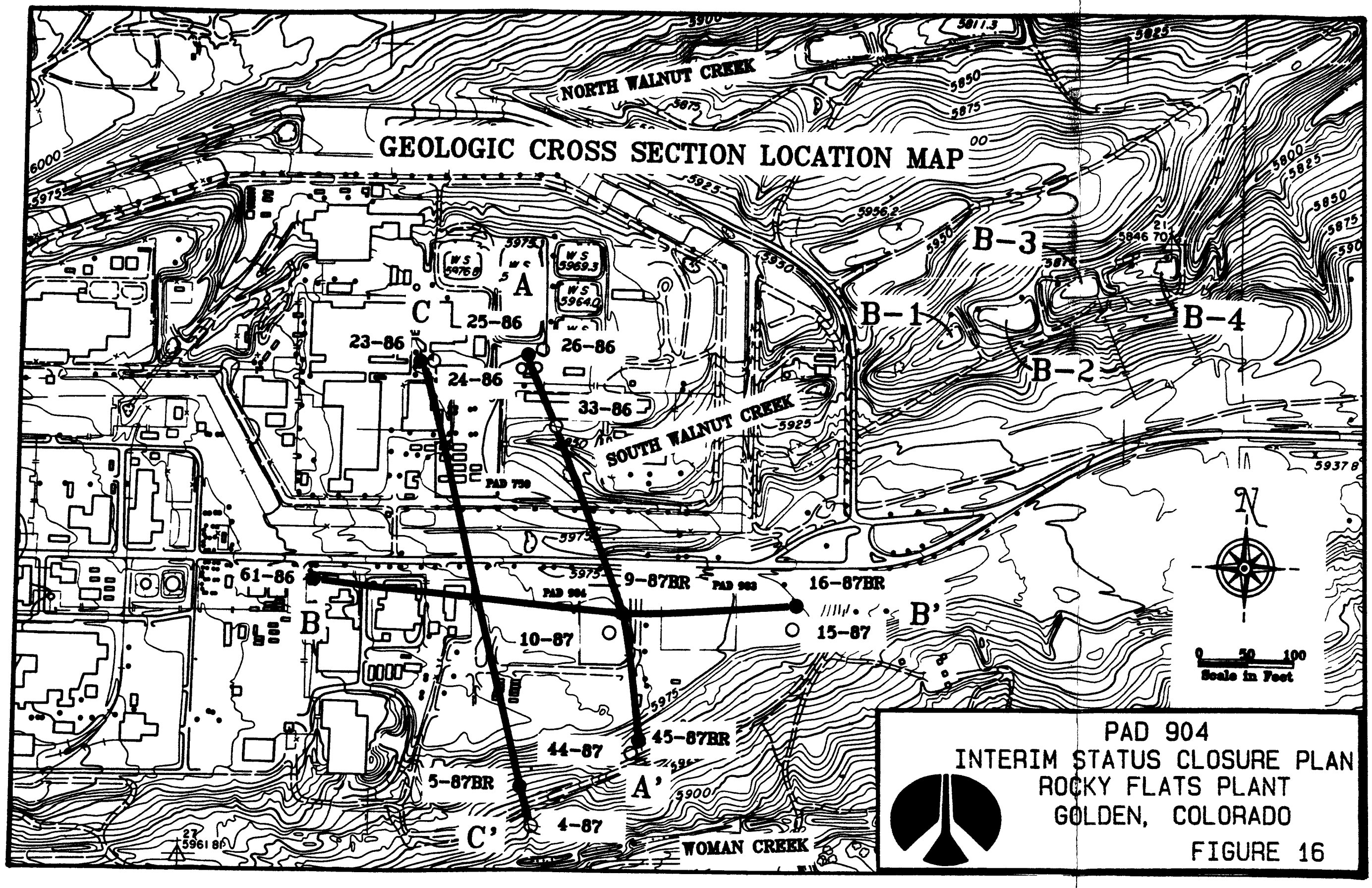
FIGURE 14

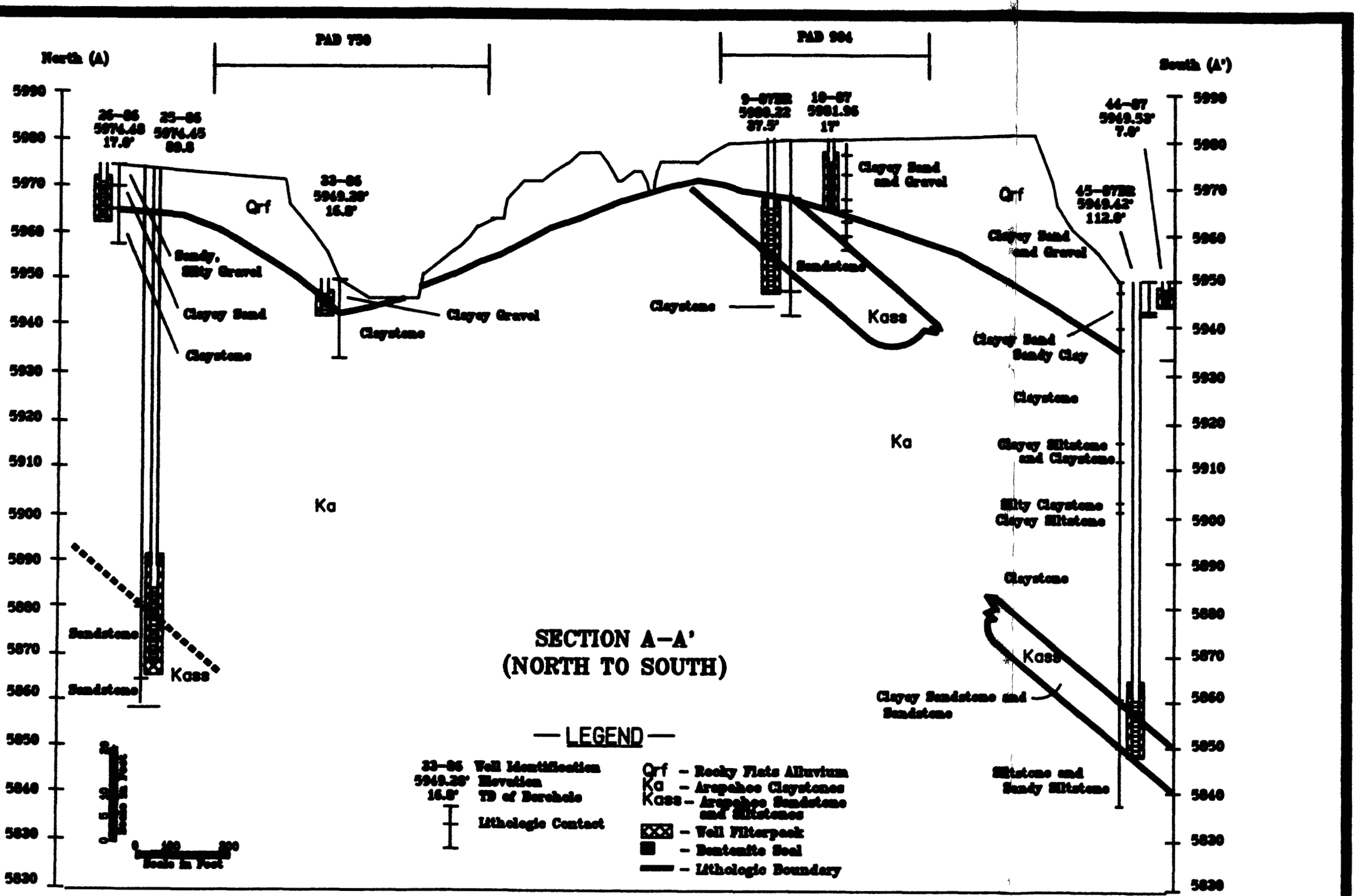


TOTAL URANIUM ISOCONCENTRATIONS IN SOIL (OCTOBER 24, 1988)–pCi/gm

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

FIGURE 15


GEOLOGIC CROSS SECTION LOCATION MAP
NORTH WALNUT CREEK
SOUTH WALNUT CREEK
WOMAN CREEK
B-1
B-2
B-3
B-4
A
A'
B
B'
C
C'
23-86
24-86
25-86
26-86
33-86
61-86
9-87BR
16-87BR
10-87
15-87
44-87
45-87BR
5-87BR
4-87
PAD 730
PAD 904
PAD 903
N
0 50 100
Scale in Feet
PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO
FIGURE 16



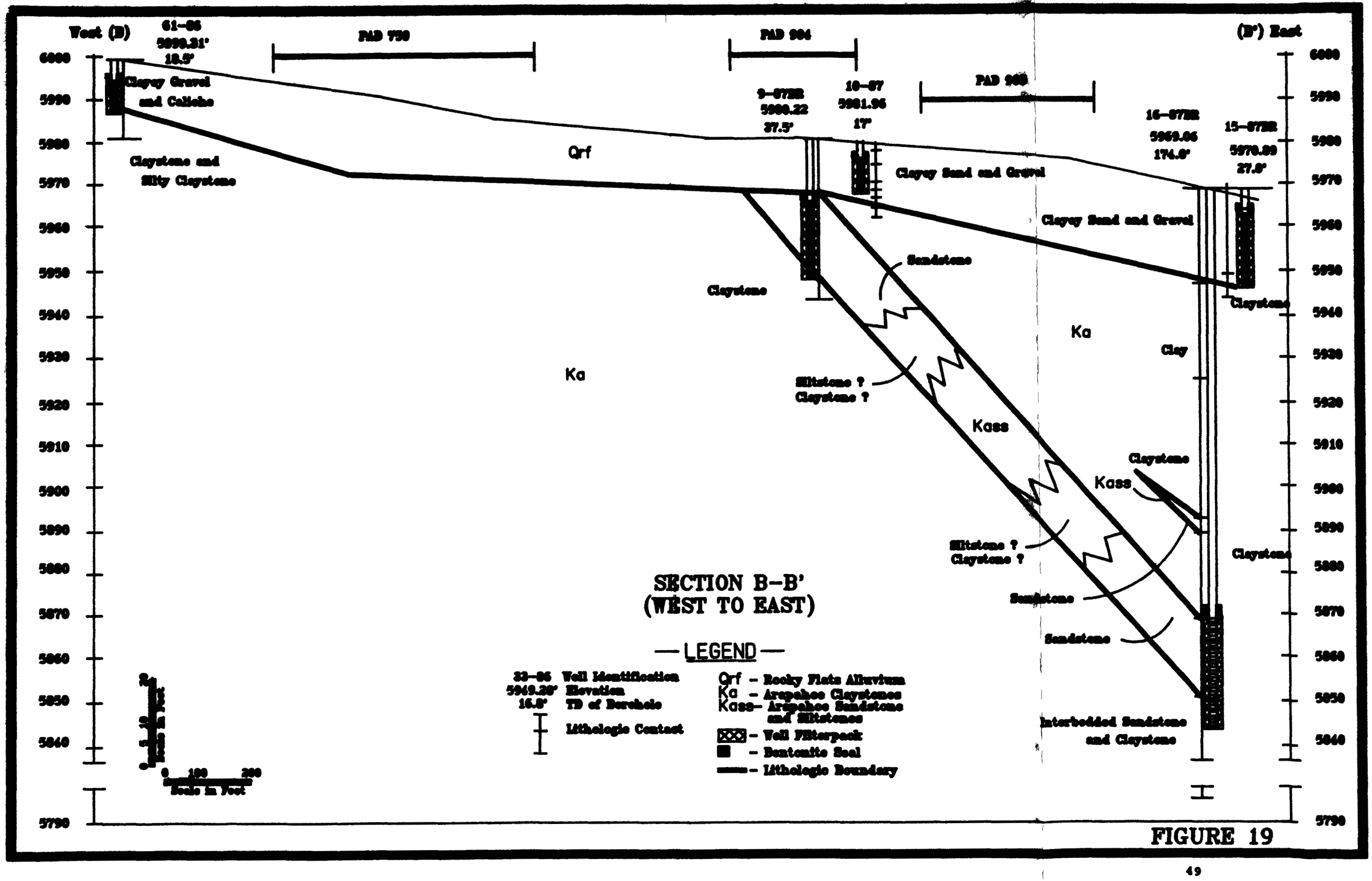
SECTION A–A'
(NORTH TO SOUTH)

— LEGEND —

23-86 Well Identification
5949.29' Elevation
16.5' TD of Borehole
Lithologic Contact

Qrf – Rocky Flats Alluvium
Ka – Arapahoe Claystones
Kass – Arapahoe Sandstone and Siltstones
– Well Filterpack
– Bentonite Seal
– Lithologic Boundary

FIGURE 18

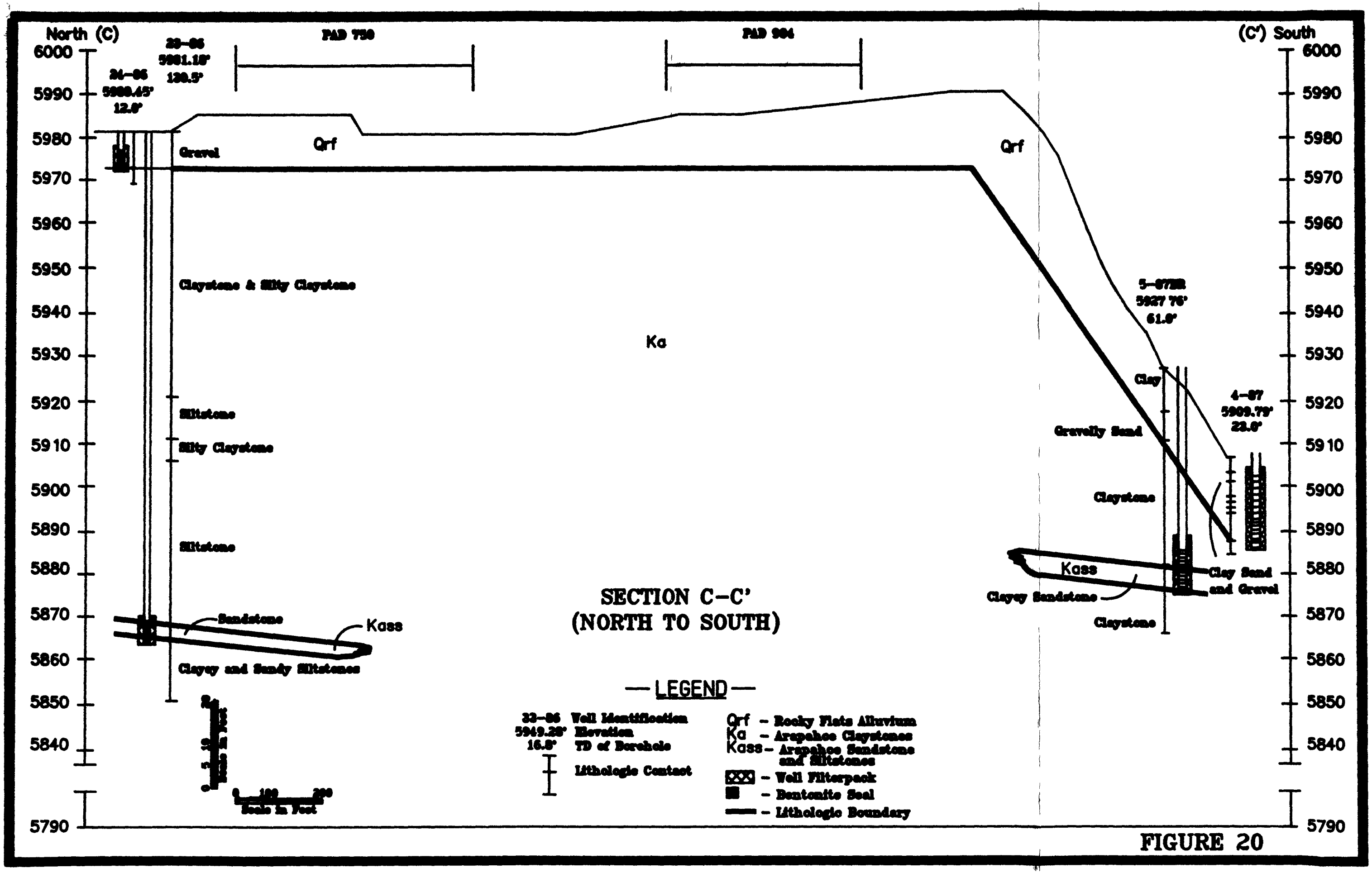


SECTION B-B'
(WEST TO EAST)

— LEGEND —

- 33-86 Well Identification
- 5949.28' Elevation
- 16.8' TD of Borehole
- Lithologic Contact
- Qrf - Rocky Flats Alluvium
- Ka - Arapahoe Claystones
- Kass - Arapahoe Sandstone and Siltstones
- Well Filterpack
- Bentonite Seal
- Lithologic Boundary

FIGURE 19



SECTION C-C'
(NORTH TO SOUTH)

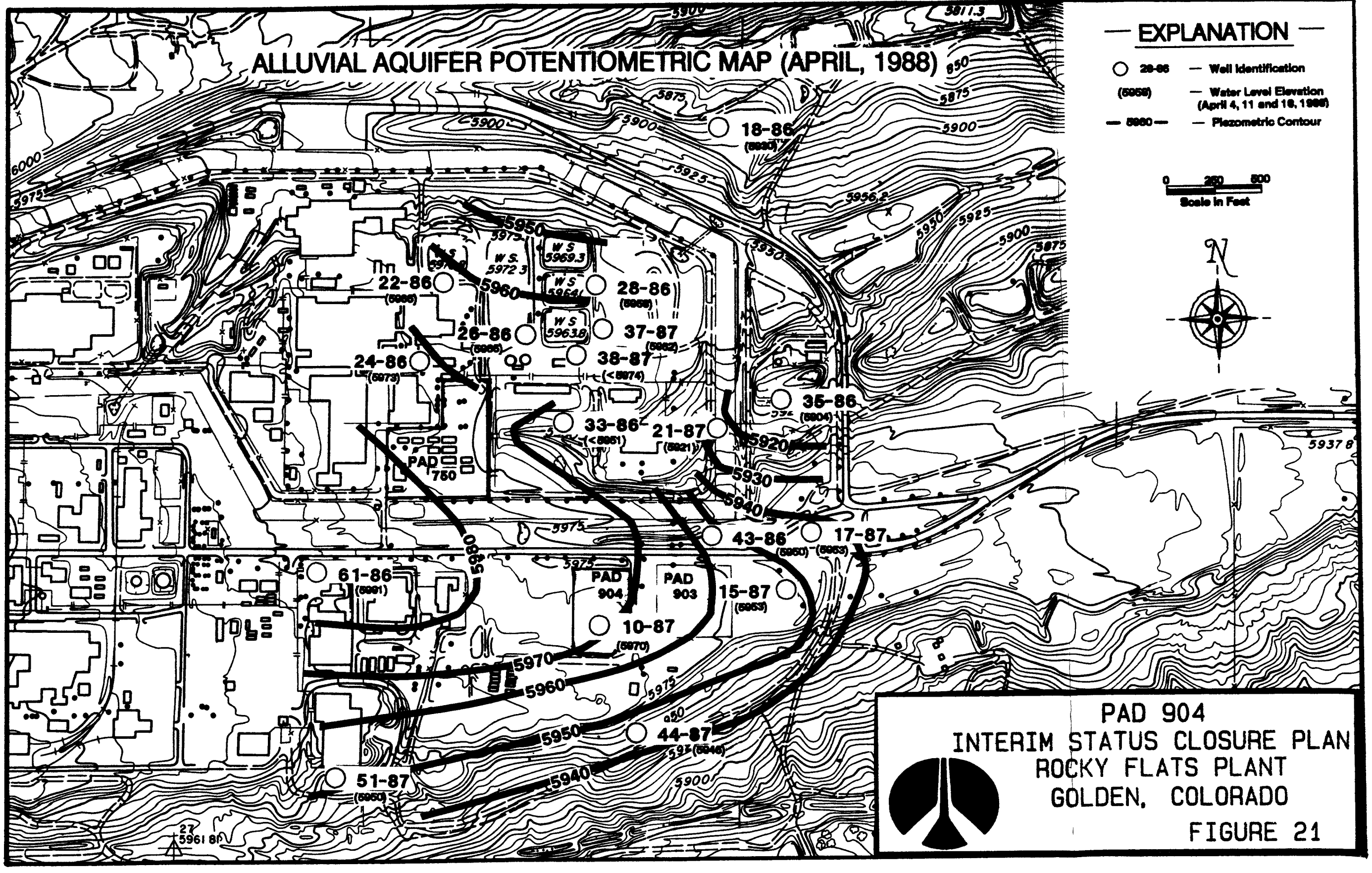
— LEGEND —

23-86 Well Identification
5949.28' Elevation
16.8' TD of Borehole
Lithologic Contact

Qrf - Rocky Flats Alluvium
Ka - Arapahoe Claystones
Kass - Arapahoe Sandstone and Siltstones
- Well Filterpack
- Bentonite Seal
- Lithologic Boundary

FIGURE 20

ALLUVIAL AQUIFER POTENTIOMETRIC MAP (APRIL, 1988)



EXPLANATION

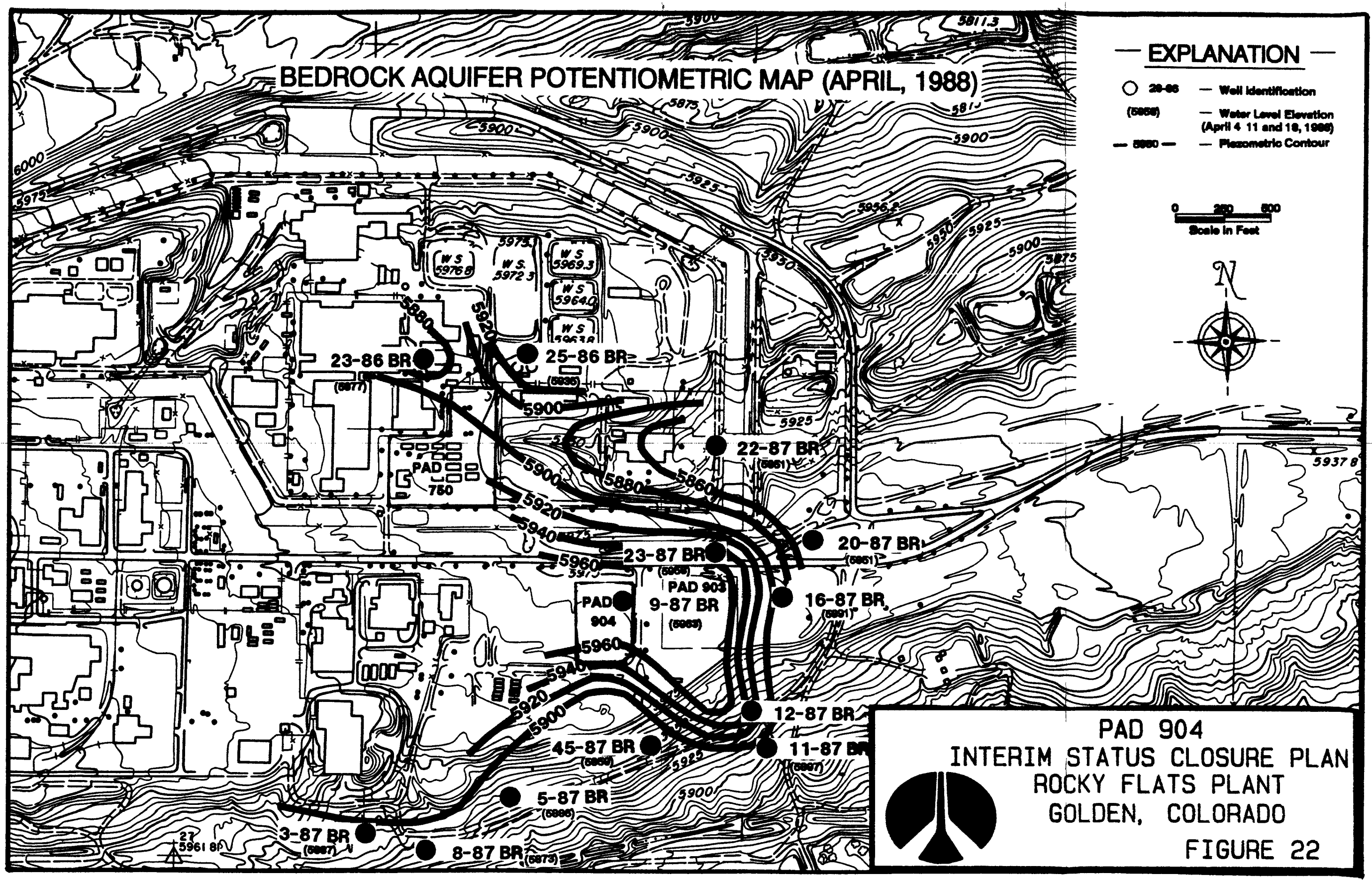
- 28-86 — Well Identification
- (5956) — Water Level Elevation (April 4, 11 and 18, 1988)
- 5950 — Piezometric Contour

0 250 500
Scale in Feet

N

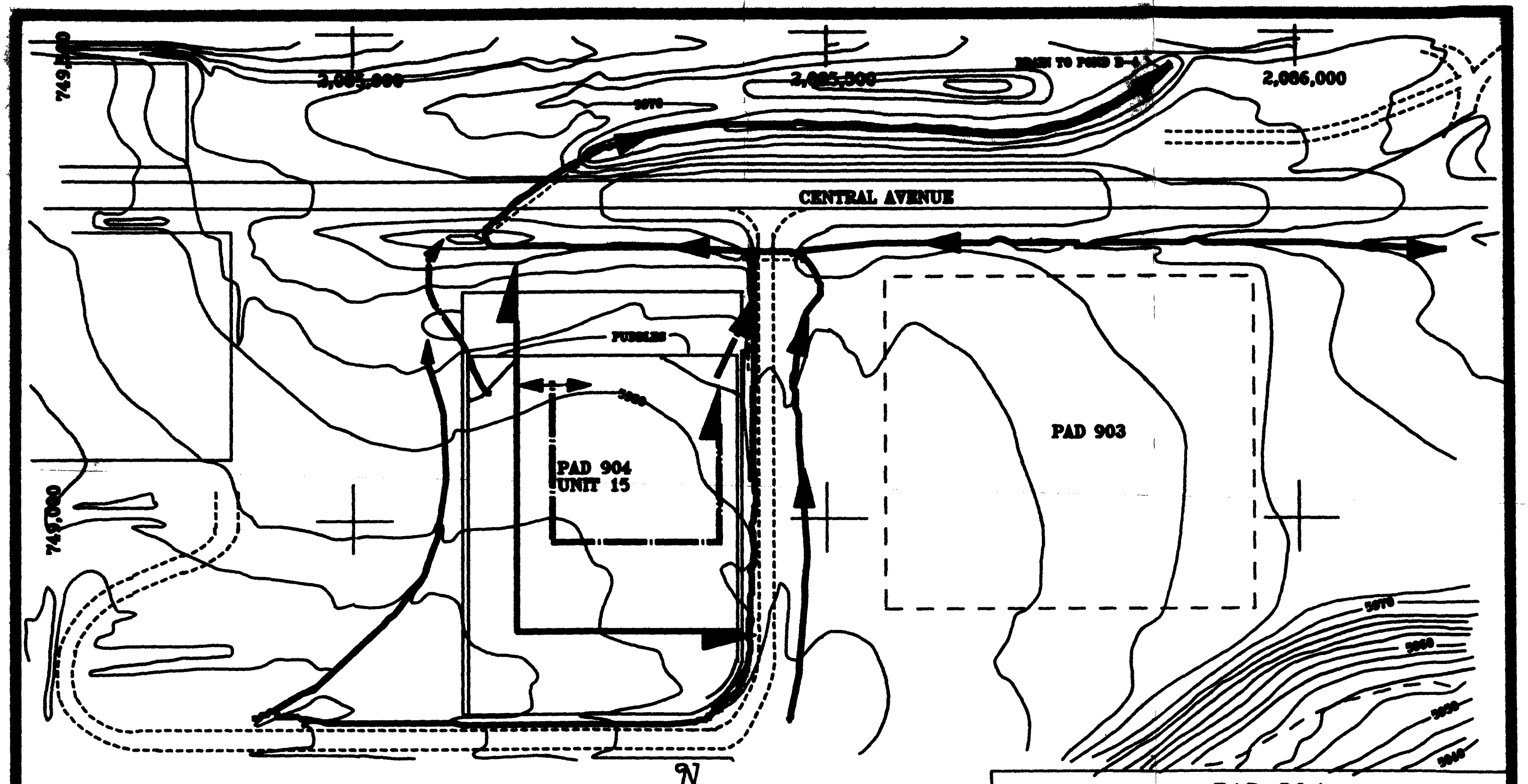
PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO
FIGURE 21

BEDROCK AQUIFER POTENTIOMETRIC MAP (APRIL, 1988)



PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

FIGURE 22



PAD 904 - SURFACE WATER FLOW PATTERNS

PAD 904
INTERIM STATUS CLOSURE PLAN
ROCKY FLATS PLANT
GOLDEN, COLORADO

FIGURE 23